Early Detection and Prevention of Chronic Kidney Disease

by

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Submitted in fulfilment of the requirements for the Degree of Philosophy

University of Tasmania

October, 2017

Declaration

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Statement of Co-Authorship

Given that this thesis is presented as a series of papers, either published, in press or submitted, a statement of co-authorship is provided for each chapter. Due to this thesis format some repetition is inevitable.

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Paper 1 (Published)

Gheewala PA, Zaidi STR, Jose MD, Bereznicki L, Peterson GM, Castelino RL. Effectiveness of targeted screening for chronic kidney disease in the community setting: a systematic review. *Journal of Nephrology*. 2017:1-10.

Located in Chapter 1

Candidate acted as the corresponding author and contributed towards conception and design of the systematic review; data extraction and synthesis; data analysis and interpretation; and writing the manuscript.

Authors 1-5 contributed towards conception and design of the systematic review; data analysis and interpretation; and revising the manuscript critically for important intellectual content.

Paper 2 (Published)

Gheewala PA, Peterson GM, Zaidi STR, Bereznicki L, Jose MD, Castelino RL. A web-based training program to support chronic kidney disease screening by community pharmacists. *International Journal of Clinical Pharmacy*. 2016; 38:1080-6.

Located in Chapter 2

Candidate acted as the corresponding author and contributed towards conception and design of the study; data acquisition; data analysis and interpretation; and writing the manuscript.

Authors 1-5 contributed towards conception and design of the study; data analysis and interpretation; and revising the manuscript critically for important intellectual content.

Paper 3 (Under review)

Gheewala PA, Peterson GM, Zaidi STR, Jose MD, Castelino RL. Evaluation of A Chronic Kidney Disease Risk Assessment Service in Community Pharmacies

Located in Chapter 3

Candidate acted as the corresponding author and contributed towards conception and design of the study; data acquisition; data analysis and interpretation; and writing the manuscript.

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Paper 4 (Under review)

Gheewala PA, Peterson GM, Zaidi STR, Jose MD, Castelino RL. Community Pharmacists' Experience of Implementing A Chronic Kidney Disease Risk Assessment Service: A Qualitative Study

Located in Chapter 4

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Paper 5 (Under review)

Gheewala PA, Peterson GM, Zaidi STR, Jose MD, Castelino RL. Patient satisfaction with a chronic kidney disease risk assessment service in community pharmacies

Located in Chapter 5

Candidate acted as the corresponding author and contributed towards conception and design of the study; data acquisition; data analysis and interpretation; and writing the manuscript.

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Paper 6 (Under review)

Gheewala PA, Peterson GM, Zaidi STR, Jose MD, Castelino RL. Knowledge about Chronic Kidney Disease (CKD) in the Australian Public Evaluated Using A New Validated Questionnaire: A Cross-Sectional Study

Located in Chapter 6

Candidate acted as the corresponding author and contributed towards conception and design of the study; data acquisition; data analysis and interpretation; and writing the manuscript.

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Acknowledgements

To my father, Ajay Gheewala: my biggest role model. Without his high and realistic expectations of me, I would have never accomplished this milestone. To my mother, Alpa Gheewala: my one and only true friend. Without her positive outlook and unconditional support during the lowest phases of my life, this would not have been possible. My parents have always taught me to see failure as a pathway towards success. They make me realise every day that nothing is impossible in this world. This thesis is dedicated to them…

I am thankful to my elder brother Jay Gheewala, for setting a benchmark and always encouraging me to aim higher.

To all my good friends and cousins who still don't understand why I chose pharmacy as a career and pursued PhD, thank you for constantly reminding me that I possess better capabilities for other profession.

I would like to express sincere thanks to Prof. Gregory M. Peterson and Dr. Ronald L. Castelino, for providing me the opportunity to pursue PhD. I am grateful for their immense support, and allowing me to explore and develop my own research skills. Without their guidance this would not have been possible.

I am thankful to Dr. Syed Tabish R. Zaidi, whose innovative ideas have always inspired me to achieve more. His unique perspectives have always made me realise that there are several ways of interpreting an outcome; thus, improving my understanding of the research field.

To Prof. Matthew Jose for providing valuable insights on the thesis from a nephrologist's perspective. Also, for his valuable comments on my research manuscripts.

To Assoc. Prof. Luke Bereznicki for helping me on various facets of the project and providing guidance and expertise whenever needed.

To all public participants, community pharmacists, renal nurses and nephrologists for their participation.

A very special gratitude goes to the Tasmanian Graduate Research Scholarship for the provision of the tuition fee, and the Tasmanian Community Fund for providing funds to conduct this project. Also, to the Division of Pharmacy and School of Medicine at the University of Tasmania for providing financial support for travel and conferences.

I would like to thank all my PhD colleagues and pharmacy staff at the University of Tasmania for their support and providing a positive work environment.

Finally, sincere thanks to Madhur for constantly setting high standards which were key to my professional success. Madhur, I am grateful for your love, patience and support towards a vision beyond PhD.

List of Abbreviations

ABS	Australian Bureau of Statistics
ACR	Albumin creatinine ratio
ANOVA	Analysis of variance
AUD	Australian dollar
BMI	Body mass index
BP	Blood pressure
CAM	Complementary and alternative medicine
CENTRAL	Cochrane Central Register of Controlled Trials
CKD	Chronic kidney disease
CKD-EPI	Chronic kidney disease-epidemiology collaboration
CKD-MBD	Chronic kidney disease-related mineral and bone disorder
CVD	Cardiovascular disease
eGFR	Estimated glomerular filtration rate
eMAP:CKD	Electronic diagnosis and management assistance to primary care in chronic kidney disease
ESKD	End-stage kidney disease
GP	General practitioner
IQR	Interquartile range
KDIGO	Kidney disease: Improving global outcomes
KEY	Kidney evaluation for you
KHA	Kidney Health Australia
KHA-CARI	Kidney Health Australia's-Caring for Australasians with Renal Impairment
MAU	Microalbuminuria

MDRD	Modification of diet in renal disease
MeSH	Medical Subject Headings
NKF-KEEP	National Kidney Foundation's Kidney Early Evaluation Program
OTC	Over the counter
PCR	Protein creatinine ratio
POCT	Point-of-care testing
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PROSPERO	International prospective register of systematic reviews
RRT	Renal replacement therapy
SCr	Serum creatinine
SD	Standard deviation
SPSS	Statistical Package for the Social Sciences
TIA	Transient ischaemic attack

Abstract

Introduction

The global burden of chronic kidney disease (CKD) is significant, and largely fuelled by the epidemics of diabetes and hypertension. CKD is a major risk factor for end-stage kidney disease (ESKD), cardiovascular disease (CVD) and premature death. In Australia, data on the prevalence of CKD are limited, and the best available evidence to estimate the CKD burden is drawn from renal replacement therapy (RRT) data. At the end of 2015, the number of patients receiving RRT was 968 per million population and continuing to rise. Evidence suggests that progression and adverse outcomes of CKD can be prevented or delayed by detecting and treating the disease in its initial stages. Unfortunately, CKD is asymptomatic until the kidney function declines by up to 90%; this makes it essential to detect the disease early. Hence, many clinical practice guidelines recommend that individuals with risk factors should be screened for CKD. In light of this evidence, globally, several targeted screening programs have been implemented in various community settings. However, the overall success of these programs is uncertain. Therefore, the aim of Project I was to conduct a systematic review of the literature to determine whether targeted screening programs are effective in identification of early stages of CKD.

Despite advancements in the early detection and prevention of CKD, availability of clinical practice guidelines, and development of risk stratification tools, 17% of new patients were referred late to nephrologists for the management of ESKD in Australia. Pharmacists are highly accessible and in a good position to engage people within the community who are not aware of their risks and less likely to access general practice care. Thus, a pharmacist-initiated CKD risk assessment service could help to identify at-risk patients and refer them to general

practitioners (GP) for further evaluation and management. Therefore, the aim of Project II was to implement and evaluate a CKD risk assessment service in community pharmacies.

Public awareness of CKD is an important determinant of the uptake of screening programs, which may help to address the CKD burden. However, there is a lack of understanding amongst the Australian community about the preventability of major health conditions. Additionally, even amongst sub-group of Australian cohorts with the greatest risk of CKD, the knowledge of CKD risk factors and the recall of kidney function testing were found to be limited. Hence, a final Project III to determine the Australian public knowledge about CKD was conducted.

Aim of the thesis

The overall aim of this thesis was to identify and implement strategies that could help to improve the early detection and management of CKD in Australia.

Methods

Project I

All observational studies of targeted screening programs implemented in any community-based setting were systematically identified and analysed. The main outcome measures were the percentage of participants with positive screening results and diagnosed with CKD at follow-up, and screening tests used to detect evidence of CKD.

Project II

A prospective cohort study in 24 Tasmanian community pharmacies was conducted. Prior to implementation, community pharmacists were trained to perform the CKD risk assessment service. Pharmacists were required to identify people with CKD risk factors and recruit them for risk assessment. The QKidney® risk calculator was used to estimates the eligible participants' five-year percentage risk of developing moderate-severe CKD. Participants

identified with ≥ 3% risk were referred to their GP and followed-up after nine months. Next, laboratory data were collected from the pathology provider. The main outcome measures were rates of GP referral uptake and of participants who underwent estimated glomerular filtration rate (eGFR) and urine albumin creatinine ratio (ACR) measurement. Community pharmacists' qualitative interviews were conducted, post-intervention, to explore the challenges faced by them during the implementation of the CKD service. Lastly, patient satisfaction with the CKD service was evaluated using a nine-item satisfaction survey which also included an additional question on willingness to pay.

Project III

A 24-item CKD knowledge questionnaire was developed, validated and used to conduct an online cross-sectional survey of the Australian public. Participants could achieve a maximum score of 24 on the questionnaire. Next, a standard multiple regression analysis was performed to identify predictors of the public knowledge of CKD.

Results and discussion

Project I

Out of nine studies included in the systematic review analysis, eight reported the percentage of participants with positive screening test results, which ranged from 7% to 60.3%. The percentage of participants diagnosed with CKD at follow-up was reported by only two studies, which was 17.1% and 20.5%. The most commonly used screening tests were ACR (≥ 3.4 mg/mmol) and eGFR (< 60 mL/min/1.73m^2).

Our analysis showed that although a considerable percentage of participants are being identified with positive screening test results, follow-up diagnostic tests for these participants was either not reported or performed by many studies. In general, this review indicated that screening programs should appropriately use the clinical guidelines in order to detect CKD.

These steps are vital to determine the actual effectiveness of targeted screening and prevent over-diagnosis.

Project II

A total of 389 participants were recruited by the pharmacies, 203 (52.1%) of whom had ≥ 3% five-year risk of developing moderate-severe CKD and were referred to their GP. Follow-up was successful for 126 participants and showed low (27%) GP referral uptake. Analysis of the pathology data revealed suboptimal kidney testing in participants with ≥ 3% risk, with eGFR and ACR tests performed for only 52.7% and 25.1% of these participants, respectively. Thus, although the in-pharmacy CKD risk assessment service, with its targeting, identified a high proportion of people at ≥ 3% risk of developing moderate-severe CKD within five years, the low GP referral uptake was a major hindrance to the efficacy of the service.

The qualitative analysis showed that pharmacists found the CKD service to be efficient, user-friendly and of significant benefit to their customers. However, several pharmacists observed that customers lacked interest in disease prevention, and had limited understanding of CKD. More importantly, pharmacists perceived the scope of pharmacy practice to be significantly dependent on the inter-professional collaboration between pharmacists and general practitioners (GPs), and customers' acknowledgement of the role of pharmacists in disease prevention.

Responses to the satisfaction survey (n = 143) revealed that the majority of the participants agreed that the time required to undergo the risk assessment process was justified (90.2%), overall they were satisfied with the CKD risk assessment service (90.0%), and they felt comfortable with the pharmacist referring their results to their doctor (88.9%). Of 136 participants who answered the question on willingness to pay, 62.9% indicated that they would pay for the CKD service.

Project III

A total of 934 participants (Australian public ≥ 18 years) provided complete responses to the CKD knowledge questionnaire. The mean (SD) knowledge score of the Australian public was 10.3 (± 5.0) out of 24. In the multivariate analysis, the statistically significant predictors of the knowledge score were level of education, marital status (lower scores in those who were single/never married), a family history of kidney failure and a personal history of diabetes. The results of this survey showed that the Australian public knowledge of CKD was relatively poor.

Conclusion

Overall, the projects described in this thesis identified some effective strategies which could help to improve the early detection and management of CKD, and consequently, reduce its burden in Australia. Primarily, it was established that any targeted CKD screening program must adhere to the clinical practice guidelines on early CKD detection, prevention and management. Next, it was determined there is a significant scope for improving the public awareness of CKD and its early detection via implementation of a community pharmacy-based CKD risk assessment service. However, there is a need to explore effective strategies which would help to improve the inter-professional collaboration between community pharmacists and GPs. Additionally, integrating the CKD service with other pharmacy services, such as medication review, and providing verbal education to participants during risk assessment may help to improve its feasibility. Lastly, it was ascertained that there is a need to improve the public understanding of kidneys and knowledge on CKD through nationwide awareness programs.

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General Introduction

Epidemiology of chronic kidney disease

The global health burden of chronic kidney disease (CKD) is significant.[1] As per the 2013 'Global Burden of Disease Study', between 2005 and 2013, the global age-standardised mortality rate for CKD increased by approximately 37%, over that period, making it one of the five main causes of reduced life expectancy worldwide.[2] Based on the 2013 'Australian Health Survey: Biomedical results for Chronic Diseases' data, approximately 1 in 10 adults (≥ 18 years) in Australia have clinical evidence of CKD such as reduced kidney function and/or albuminuria.[3] Interestingly, less than 10% are aware that they have this condition.[3]

CKD is defined as damage to the kidney or decline in the kidney function present for ≥ 3 months.[4, 5] The decline in the kidney function is indicated by a reduction in the estimated glomerular filtration rate (eGFR) below 60 mL/min/1.73m^2. The structural damage to the kidneys is indicated by excessive amounts of protein (mainly albumin) in the urine, and CKD is diagnosed when the urine albumin creatinine ratio (ACR) is > 2.5 mg/mmol for males and > 3.5 mg/mmol for females.[5] CKD is classified into 5 stages by combining both eGFR and albuminuria categories, irrespective of the underlying cause (Table A).[4, 6]

Table A. Chronic kidney disease classification by eGFR and albuminuria categories[4, 5]

			Albuminuria categories (urine ACR mg/mmol)		
			Normal	Microalbuminuria	Macroalbuminuria
			Male: < 2.5 Female: < 3.5	Male: 2.5-25 Female: 3.5-35	Male: > 25 Female: > 35
eGFR categories (mL/min/1.73m^2)	Stage 1	≥90			
	Stage 2	60-89			
	Stage 3a	45-59			
	Stage 3b	30-44			
	Stage 4	15-29			
	Stage 5	<15			

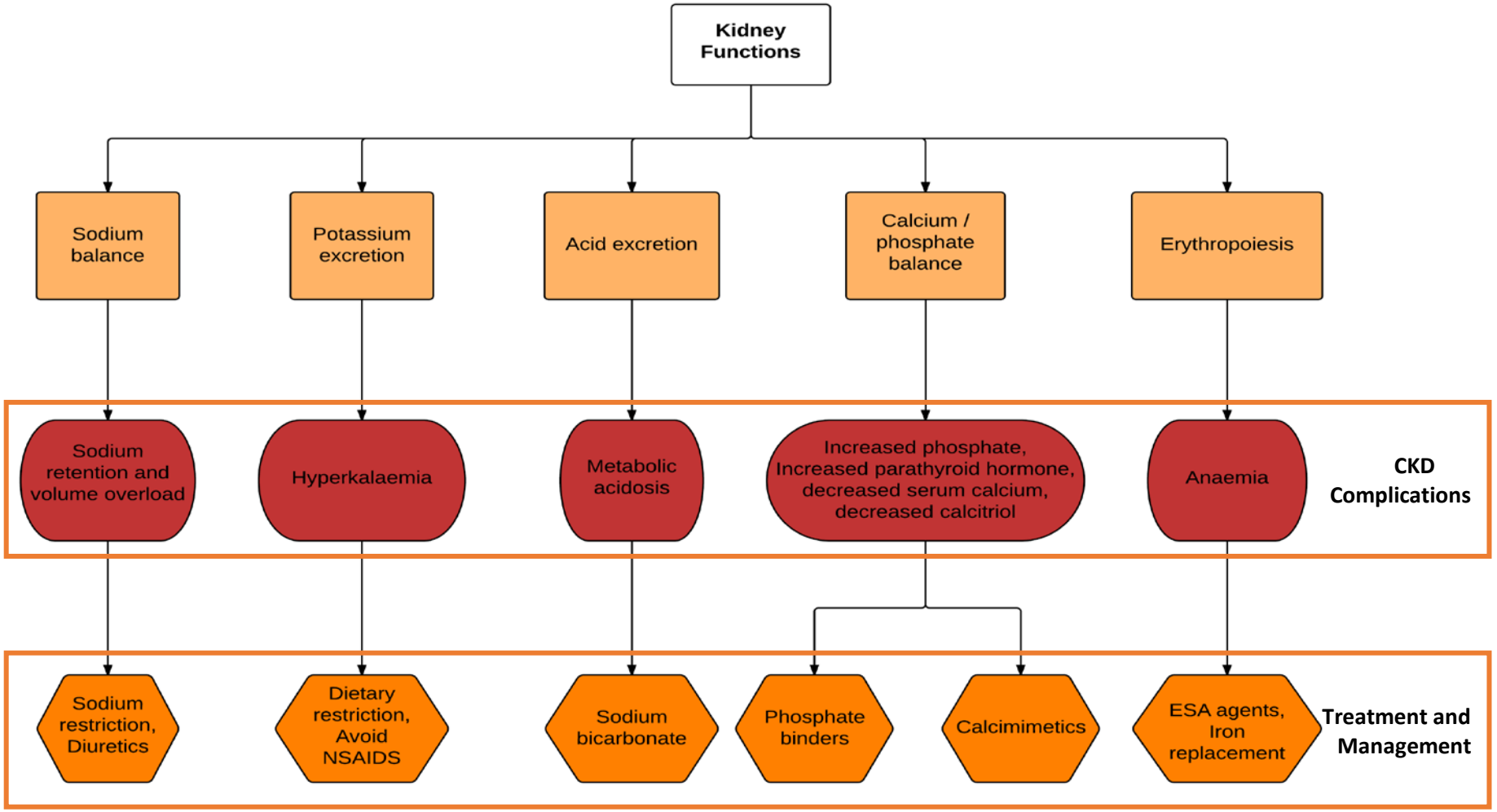
eGFR estimated glomerular filtration rate; ACR albumin creatinine ratio

Green – Low risk (if no other markers of kidney disease, no CKD); Yellow – Moderately increased risk; Orange – High risk; Red – Very high risk.

CKD causes a huge economic burden on the healthcare system and is associated with significant morbidity and mortality.[7, 8] It is a major risk factor for end-stage kidney disease (ESKD) or stage 5 CKD, cardiovascular disease (CVD) and premature death.[9] Advanced stages (4-5) of CKD can cause several health complications such as sodium retention, volume overload, hyperkalaemia, metabolic acidosis, hypertension, CKD-related mineral and bone disorder (CKD-MBD) and anaemia (Figure A).[5, 10]

CKD is generally asymptomatic in nature until the kidney function declines by up to 90%.[5, 11] Therefore, patients with CKD may not notice any symptoms until they reach ESKD. General symptoms of ESKD include: lethargy, nocturia, anorexia, nausea, vomiting, malaise, pruritus, restless legs, and dyspnoea.[10, 12]

Figure A. Complications associated with chronic kidney disease.



CKD chronic kidney disease NSAIDS Non-steroidal anti-inflammatory drugs ESA Erythropoietin stimulating agents.

People with CKD require extensive hospital services, particularly those individuals with ESKD who need regular renal replacement therapies (RRT), such as dialysis or transplantation, for survival.[13] Additionally, in patients with stage 4 CKD, death prior to RRT is more than twice as likely as progression to ESKD.[14]

In Australia, kidney disease contributes towards approximately 15% of all hospitalisations. As per the Australian Institute of Health and Welfare, the number of new patients commencing RRT has more than doubled between 1991-2010, and Australia has already spent over $760 million on RRT.[13] Moreover, the estimated costs to the Australian government for treating ESKD, between 2009-2020, is between approximately $11.3 billion and $12 billion AUD.[15]

The prevalence of CKD increases disproportionately in older people because of the age-related decline in the GFR of an average 8 mL/min/1.73m^2 per decade, after the age of 30 years.[16] Additionally, the increase in CKD prevalence is fuelled by the rising rates of diabetes and hypertension, which are its principal risk factors.[1, 17] Of high concern is the analysis from a recent systematic review which reported that the prevalence of estimated impaired kidney function (particularly eGFR 30-59 mL/min/1.73m^2) in the adult general population was common and similar to that of diabetes mellitus.[18] In Australia, the primary causes of ESKD are diabetes (36%), glomerulonephritis (23%) and hypertension (14%). Also, the mean age of new patients commencing RRT, in 2014, was 57.7 and 60.9 years, for female and male, respectively.

Early detection and prevention of CKD

The risks of CKD progression and CVD can be reduced by up to 50% if CKD is detected in its initial stages (1-3), and appropriate management strategies are implemented.[5, 6] These strategies include better management of comorbidities such as hypertension and diabetes, and discontinuation of medications that are nephrotoxic or considered problematic in renal impairment.[19-22] Previous studies[23-27] have reported medication errors in CKD patients ranging from 23.5 to 69.6% in inpatients, long-term care and ambulatory settings, and that the majority of these problems are preventable if such medications are avoided or dosages appropriately adjusted in this population.

Patients with impaired kidney function are at an increased risk of adverse drug events (ADE).[28] ADE in turn may increase the risk of poor outcomes in patients with CKD, including accelerated kidney function loss, and increase the frequency or length of hospitalisation and death.[28] A recent study reported that >10% of community dwelling older people used drugs that required dose adjustment in renal impairment and this exposure was independently associated with a 40% increased mortality in people with impaired kidney function.[29]

Thus, clinical practice guidelines such as the 'Kidney Health Australia's – Caring for Australasians with Renal Impairment' (KHA-CARI) guideline on 'Early CKD: Detection, prevention and management', and 'Kidney Disease: Improving Global Outcomes' (KDIGO) guideline for the 'Evaluation and Management of Chronic Kidney Disease' were developed.[4, 6] The KHA-CARI guideline[6] recommends screening of people with established CKD risk factors as an effective strategy to reduce the increasing CKD burden in Australia.

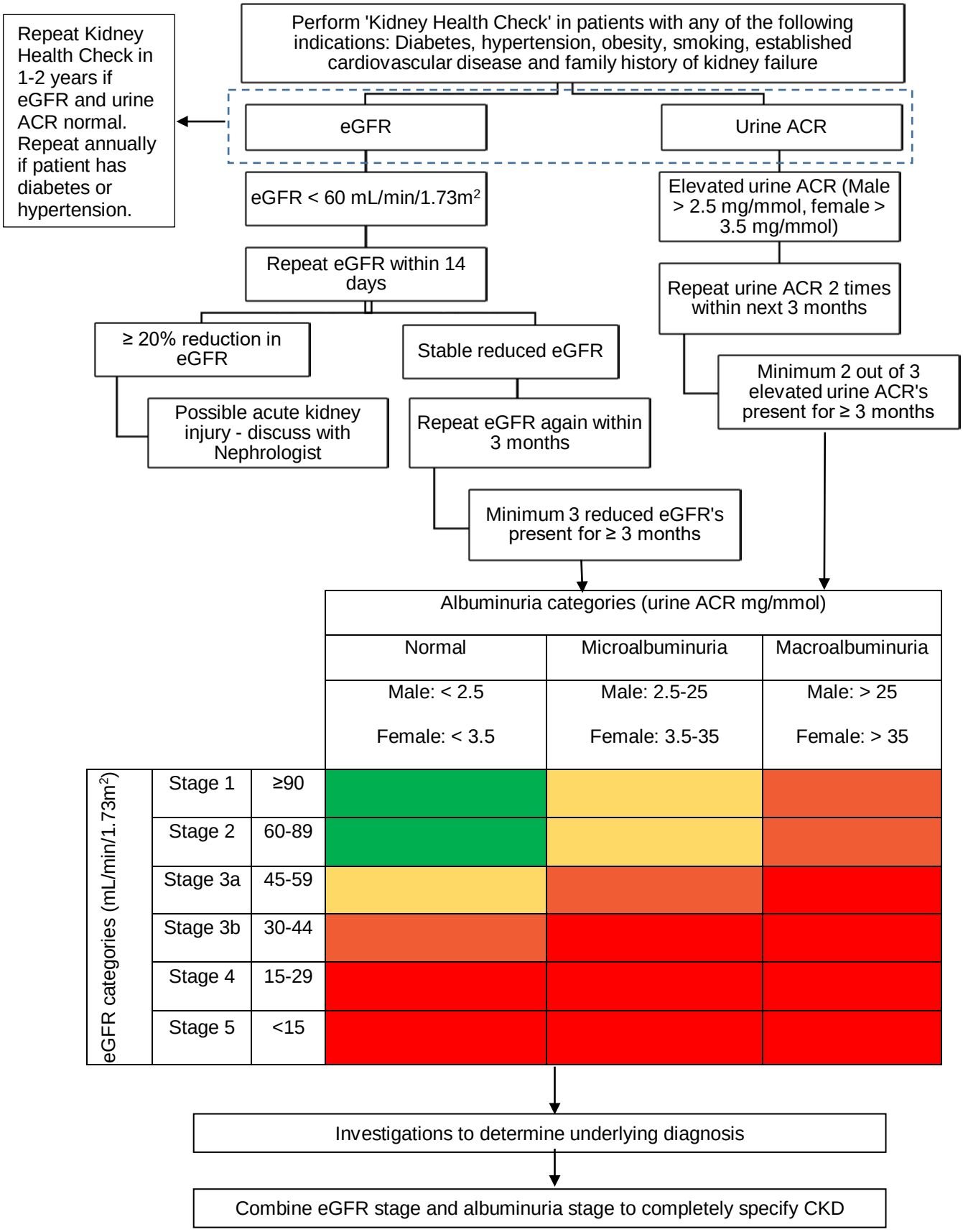
As per the KHA-CARI guideline,[6] testing for CKD is recommended in individuals aged ≥ 60 years, with the following risk factors:

- Smoker,
- Diabetes,

- Hypertension,
- Obesity,
- Established CVD (includes previous diagnosis of coronary heart disease, cerebrovascular disease or peripheral vascular disease), and
- Family history of CKD.

A ‘Kidney Health Check’, which includes urine ACR, eGFR, and blood pressure measurement, is indicated every 12 months in these individuals. Also, repeated testing is indicated in individuals with initial abnormal eGFR and urine ACR test results over several weeks to confirm the CKD diagnosis. Figure B shows the algorithm recommended by KHA-CARI for the initial detection of CKD.

Figure B. Algorithm for initial detection of chronic kidney disease[5]



Despite these advancements, the disease still remains underdiagnosed worldwide; and in Australia, the data on its prevalence and determinants is extrapolated merely from records of patients commencing RRT.[11, 30] Individuals with stage 1-4 of CKD may not be identified because of a failure to use laboratory measurements of renal function in high-risk patients and the asymptomatic nature of early CKD.[28] Although the implementation of automated GFR reporting, when a serum creatinine level is requested, has helped to identify CKD early, studies have reported that practitioners may not take appropriate action or tailor their care in patients with impaired kidney function.[31-33]According to the KHA's CKD management in general practice recommendations, referral to a nephrologist is indicated when the eGFR is < 30 mL/min/1.73m^2, the persistent urine ACR is ≥ 30 mg/mmol or there is a consistent decline in eGFR from a baseline of < 60 mL/min/1.73m^2.[5] However, at the end of 2014, approximately 17% of new patients were referred late to nephrologists for the management of ESKD in Australia.[17] In addition, the median eGFR in new patients commencing RRT was low at 7.4 mL/min/1.73m^2.

CKD among Australian older adults within primary care settings is common, and drastically under-recognised and under-treated.[12] The AusHEART study which aimed to determine the prevalence of CKD in the Australian primary care settings showed that out of 37% patients with abnormal kidney function, < 18% were appropriately identified with CKD.[12] Similarly, a retrospective study found that despite the increasing prevalence of CKD in the state of Tasmania, Australia, testing for kidney disease (i.e. serum creatinine and albuminuria) in at-risk people was suboptimal.[34]

All the above evidence indicates significant practice gaps and the need to improve early CKD detection in Australia. Thus, the Electronic Diagnosis and Management Assistance to Primary Care in Chronic Kidney Disease (eMAP:CKD) program was developed and implemented within 22 primary care settings located in the north west Melbourne, in the state

of Victoria, Australia.[35] The aim of the eMAP:CKD program was to identify patients at risk of CKD and provide guidance to general practitioners (GPs) for appropriate further testing, diagnosis and management. This study showed a significant improvement in urine ACR testing and CKD documentation after 15 months of program implementation; however, this study did not perform repeated testing in at-risk patients to confirm the CKD diagnosis. Hence, effective alert strategies to identify patients at risk, and promote collaboration between health care practitioners to improve outcomes especially in individuals at risk for continuous kidney function loss are essential. Collaboration with community pharmacists has been identified as an essential step in improving patient safety in CKD.[28]

Community pharmacists' role in health promotion and disease prevention

Although it has been established that targeted screening can help to reduce the burden of CKD,[6] currently, screening for CKD is not practised in Australia.[11] Only one Australian screening program performed in community settings suggested that implementation of targeted 'opportunistic' screening within primary care settings might be a sustainable approach.[36] However, owing to the rise in the prevalence of several chronic diseases, most (GPs) give priority to interventions for management of patients with established chronic diseases.[37-39] Subsequently, the high patient workload makes it difficult for GPs to participate in interventions for health promotion and disease prevention.[37-39] A recent qualitative study investigating the barriers and facilitators of CKD screening by general practice nurses showed that currently the decision to conduct screening was determined by GPs, who perceived the nurses' time to be financially imperative.[40] Lack of funding and inter-professional conflicts in the workplace were additionally identified as barriers to nurse initiated CKD screening.

Community pharmacists' role in the provision of screening services for various chronic diseases such as diabetes,[41-43] CVD,[44] osteoporosis[45, 46] and atrial fibrillation[47] has recently gained attention. Most of these studies indicated that pharmacists can make a noteworthy contribution in the early diagnosis and disease prevention strategies by conducting screening or risk assessment services. This is because community pharmacists are highly accessible healthcare professionals, and more likely to identify those people within the community who do not regularly access general practice care.[48]

In France, a community pharmacist-initiated intervention in patients at risk of, or suffering from, CKD has been shown to identify and alert GPs of inappropriate prescribing of drugs which need dosage adjustment, or are contraindicated, in renal impairment.[49] In this study, pharmacists underwent a four-hour course on general knowledge of CKD and prescription adjustment for renal impairment. Eligible patients' serum creatinine value was measured with

the help of a medical biologist, and eGFR was also calculated. This study identified renal impairment (<60 mL/min/1.73m^2) in 24.5% of its participants; however, repeated testing was not performed to confirm CKD diagnosis. Another study determining the feasibility of point-of-care creatinine testing in community pharmacy settings identified > 50% participants with mild (50-80 mL/min/1.73m^2) to moderate (30-49 mL/min/1.73m^2) CKD.[50] In the western province of Canada, Alberta, the community pharmacists' scope of practice has expanded, allowing them access to order and view patient laboratory data.[51] These pharmacists applied the clinical guidelines for the screening and identification of CKD, and detected 39% participants with CKD, out of which 40% were previously undiagnosed cases of CKD. These findings indicate that pharmacist-initiated targeted CKD screening intervention could provide significant patient benefit and help to improve the early CKD detection.

At present, community pharmacists in Australia do not have access to order or retrieve patient laboratory data. This might change with the increased uptake of the online health information recording system called 'My Health Record', initiated by the Australian government.[52] 'My Health Record' allows patient details such as allergies, current conditions and treatments, medicine details, pathology reports or diagnostic imaging scan reports to be digitally stored in one place. Use of this recording system will allow greater patient information sharing amongst healthcare professionals in Australia. However, this system was developed recently and hence, it might take some time before its use becomes commonplace within routine practice and accepted by both consumers and health professionals.

Currently, the lack of Australian community pharmacists' access to laboratory data, prevents them from directly implementing the KHA-CARI clinical guidelines for early CKD detection and prevention. However, community pharmacists can still play an essential role by performing risk assessment and referring people at high risk of developing CKD to their GP for further diagnostic evaluation.

Risk assessment interventions for other diseases in community pharmacy settings have shown potential.[42, 44, 53, 54] Similarly, implementation of a CKD risk assessment service in community pharmacy settings could also prove to be beneficial. In recent years, several risk stratification tools that can identify individuals at a higher risk for future CKD have been developed worldwide.[55-60] One such tool recommended by the KHA is an online QKidney® risk calculator.[55, 56, 58, 61] This calculator is a validated algorithm which estimates a person's risk of developing moderate-severe CKD (eGFR < 45mL/min/1.73m^2) over the next five years. Implementation of the QKidney® risk calculator within community pharmacy setting, and its evaluation will help to determine whether this would be an effective approach to identify undetected cases of early CKD within the community. These findings may possibly influence the public health policy for the primary prevention of CKD in Australia.

Aim of thesis

The research presented in this thesis covers three separate, but largely related, investigations. The overall aim of this thesis was to explore, implement and evaluate strategies which could help to improve the early detection and prevention of CKD in Australia.

The three main projects were as follows:

Project I Effectiveness of targeted screening programs for detection, prevention and management of CKD in community settings: A systematic review.

Project II

(A) Impact of a web-based training program on pharmacists' knowledge and skills associated with CKD risk assessment.

(B) Evaluation of a CKD risk assessment service in community pharmacies.

(C) Community pharmacists' experience of implementing a chronic kidney disease risk assessment service: A qualitative study

(D) Patient satisfaction with a CKD risk assessment service in community pharmacies.

Project III Evaluation of the Australian public knowledge about CKD.

Each project is presented as a separate chapter in the thesis.

Preface

Chapter 1 has been published in the 'Journal of Nephrology' under the title "Effectiveness of targeted screening for chronic kidney disease in the community setting: a systematic review" (pages 1-10). The authors of this publication include: Pankti A. Gheewala, Syed Tabish R. Zaidi, Matthew D. Jose, Luke Bereznicki, Gregory M. Peterson and Ronald L. Castelino. This article was first available online on 8 February 2017 and its DOI is https://doi.org/10.1007/s40620-017-0375-0. The final publication is available at link.springer.com. The impact factor of this journal is 2.153. As mentioned under the 'Copyright Information' section of the 'Journal of Nephrology', no approval is needed from the journal for reproduction of this paper in thesis. The published paper presented under Chapter 1 has been re-formatted to maintain consistency with the rest of the thesis.

PROJECT I

CHAPTER 1. Effectiveness of Targeted Screening Programs for Detection, Prevention and Management of Early Chronic Kidney Disease in community-settings: A Systematic Review

1.1 Abstract

1.1.1 Background

Targeted screening interventions for chronic kidney disease (CKD) are increasingly being implemented in various community settings. However, the overall success of these programs is uncertain. Therefore, the aim of this review is to determine whether targeted screening is effective in detecting people with undiagnosed CKD.

1.1.2 Methods

Targeted screening program was defined as the implementation of test/s in patients with known risk factors for CKD. We performed a systematic literature review, and included observational studies of targeted screening programs implemented in any community-based setting. Studies were required to have targeted people aged ≥ 18 years, and multiple CKD risk factors from the following: diabetes, hypertension, cardiovascular disease and family history of kidney disease. The outcome measures were percentages of participants with positive screening test results and diagnosed with CKD at follow-up, and screening tests used to detect evidence of CKD including: proteinuria, albuminuria, urine albumin creatinine ratio (ACR), serum creatinine, creatinine clearance, or estimated glomerular filtration rate (eGFR)

1.1.3 Results

Nine studies met the inclusion criteria. Eight studies reported the percentage of participants with positive screening test results, which ranged from 7% to 60.3%. The percentage of participants diagnosed with CKD at follow-up was reported by 2 studies, which was 17.1% and 20.5%. The most commonly used screening tests were ACR (≥ 3.4 mg/mmol), and eGFR (< 60 mL/min/1.73m^2). All studies classified CKD stage 3 and above based on eGFR alone. Characteristics of the interventions responsible for inconsistencies in the outcome measures include CKD risk factors targeted, and screening tests used to detect CKD.

1.1.4 Conclusion

This systematic review found significant variation in the methods that were used to detect CKD, and identified that majority studies reported results based on only single albuminuria or eGFR values. Data on the percentage of participants, for whom follow-up was successful and who were diagnosed with CKD at follow-up were either unclear or not reported in many studies. Future targeted screening programs should appropriately use the clinical guideline for 'Early CKD: Detection, prevention and management' in order to detect CKD, which is necessary to determine the benefit of these programs when implemented in community settings.

1.2 Introduction

Chronic kidney disease (CKD) causes a significant economic burden on the healthcare system and is associated with reduced life expectancy and increased mortality.[8] Evidence suggests that progression and adverse outcomes of CKD can be prevented or delayed by detecting and treating the disease in its initial stages (i.e. 1-3).[8] More specifically, this involves treatment of co-existing co-morbidities, such as diabetes and hypertension, and application of measures to slow progression of early CKD, which should be initiated in stage 1 and 2 of CKD. Also, CKD is asymptomatic until kidney function deteriorates by approximately 90%, which makes it challenging to detect the disease early.[11] Furthermore, failure to identify a patient in stages 1-3 of CKD may result in an escalation of CKD complications and kidney failure, often leaving the patient inadequately prepared to commence renal replacement therapies (RRTs) for survival. This is crucial, as early referral and consultation with a nephrologist can enable better uptake of different dialysis procedures and reduce the rate of hospitalisation and mortality.[62] Hence, many clinical practice guidelines recommend that individuals with risk factors, such as hypertension, diabetes, cardiovascular disease (CVD) and a family history of kidney disease, should be screened for CKD.[63]

Current literature indicates that screening and risk stratification for CKD can be carried out by measurement of estimated glomerular filtration rate (eGFR) (which indicates level of kidney function) and/or assessment of proteinuria (marker of kidney damage).[64] Additionally, simple tests, such as dipstick urinalysis, point-of-care testing (POCT) for serum creatinine (SCr)[64] and various risk assessment tools[56, 57, 59, 65] can facilitate the early identification of patients with undiagnosed CKD in a community setting. At present, evidence exists that mass screening for CKD can result in: over-estimation of prevalence of stage 3 CKD based on eGFR, inefficient use of resources and needless anxiety in the general population.[66] Instead, screening was found

to be cost-effective and more capable of identifying unrecognised cases of CKD when performed in people at increased risk.[64]

Globally, targeted screening programs[36, 51, 67-76] have been implemented in various community settings to identify patients with early stage CKD and refer them to specialists for further diagnosis and management. However, no data synthesis has been performed to determine the overall success of these screening programs. Therefore, the aim of this systematic review was to evaluate whether targeted screening is effective in identification of people with undiagnosed CKD, and to identify characteristics that were responsible for the more effective screening interventions.

1.3 Methods

We conducted a systematic review according to a pre-specified protocol (PROSPERO [International Prospective Register of Systematic Reviews] number: CRD42016037204) as shown in Appendix 1.1 and reported in accordance with published guidelines (PRISMA).[77]

1.3.1 Selection criteria

For the purpose of this review, targeted screening was defined as the implementation of test/s in patients with known risk factors for CKD. We included observational studies (cross-sectional, case-control and prospective cohort) of targeted screening interventions that were implemented in a community-based setting, specifically aimed to identify people with undiagnosed CKD. For inclusion in this review, the screening program was required to have targeted adults (≥ 18 years) and multiple CKD risk factors from the following: diabetes, hypertension, CVD and family history of kidney disease. Screening programs could have been implemented in any community setting and performed by any healthcare professional. There were no restrictions imposed based on the length of follow-up of outcomes. No publication date restrictions were applied and articles in a language other than English were not included.

Studies that were retrospective in nature and of epidemiological design were excluded from this review. Articles that were conference abstracts, editorials, literature reviews, news, ongoing studies and case reports were excluded.

1.3.2 Data Sources and Search Strategy

An electronic search of four databases: EMBASE, PubMed, Cochrane Central Register of Controlled Trials (CENTRAL) and Scopus was conducted in February 2016, and an updated search, was performed in July 2016. Three layers of search terms (chronic kidney disease, screening and community) were piloted by using the Emtree thesaurus and Medical Subject Headings (MeSH) of EMBASE and PubMed, respectively. Wherever possible, the terms were exploded to broaden the search or searched as a keyword in titles and abstracts of articles. Text word searching was also conducted to identify any articles that may not have been indexed appropriately. The search terms were modified for use across individual databases, due to the differences in their functionality. Search strategy for individual database is shown in Appendix 1.2.

The search strategy was used to retrieve citations into EndNote X7.4. Duplicate articles were removed, and titles were screened to identify studies relevant to this review. Screening of abstracts of all retained articles was then performed, and full-texts were obtained of all articles that appeared to be potentially relevant for inclusion. Two reviewers (P.A.G. and R.L.C.) independently assessed the full-text articles for inclusion and any disagreements were resolved after consultation with third and fourth reviewers (S.T.Z. and G.M.P.). Reference lists of included studies or relevant reviews identified through the electronic search were screened to identify any potential articles.

1.3.3 Data extraction and synthesis

Data extracted from each study included: (1) Study characteristics: study design, year of publication, country of origin; (2) Participant characteristics: mean age, gender, CKD risk factors targeted; (3) Intervention type: healthcare professional involved, community setting type, length of follow-up, screening tests used to detect evidence of CKD (including proteinuria, microalbuminuria (MAU), albumin/creatinine ratio (ACR), SCr or eGFR), threshold used for positive screening test result and equation used to calculate renal function; (4) Outcome measures: percentage of participants with positive screening test results, percentage of participants for whom follow-up was successful and percentage of participants diagnosed with CKD at follow-up. We contacted two authors[74, 75] for further information. Both responded and one[74] provided unpublished numerical data.

Due to the heterogeneity in the eligibility criteria of participants, and in the screening tests and thresholds used to detect CKD, a quantitative meta-analysis was not appropriate. Study characteristics, screening program characteristics and outcome measures of the included studies are presented in the form of texts, tables, and/or figures. We also explored relationships in data i.e. considered factors that might explain observed differences between studies and the potential facilitators or barriers to successful implementation of different screening programs.

1.3.4 Risk-of-Bias Assessment

The quality of the included studies was assessed by using the Cochrane Risk of Bias Assessment Tool: for Non-Randomized Studies of Interventions (ACROBAT-NRSI).[78] This tool covers seven domains through which bias might be introduced into quantitative studies. The first two domains assessed the risk of bias that can occur before initiation of the intervention; the third domain assessed the intervention itself; and the final four domains assessed the risk of bias that can arise after the intervention has been initiated. Each domain

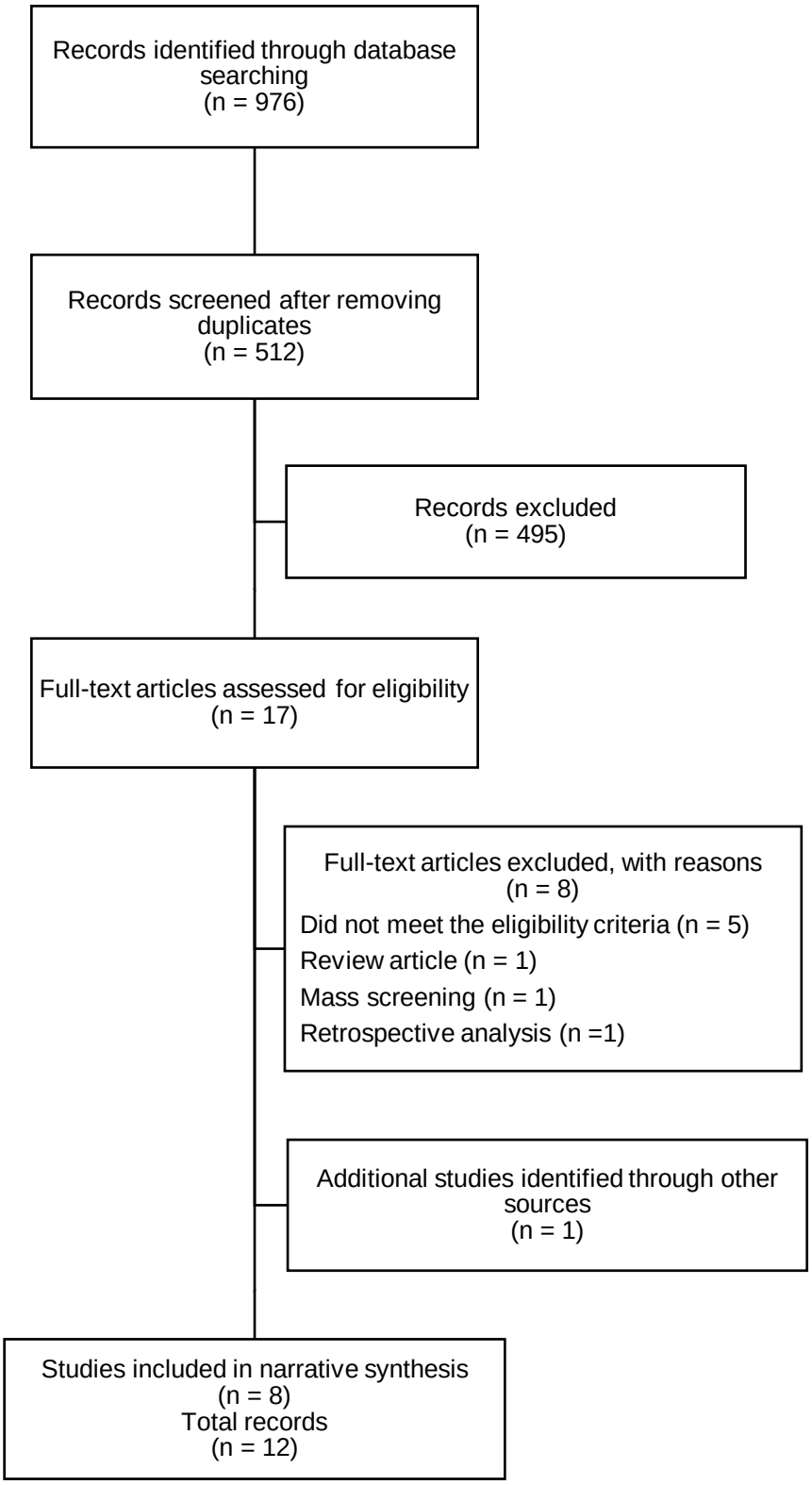
includes signalling questions which aim to facilitate judgement about the risk of bias. If the answers to the signalling questions for a domain were “yes” or “probably yes”, then the risk of bias was judged low. If the answers to the signalling questions were “no” or “probably no”, then the potential for bias was likely; a judgement was then made on the extent to which the results of the study are at risk of bias (i.e. low, moderate, serious or critical).

1.4 Results

1.4.1 Study selection

The electronic search strategy retrieved a total of 512 unique citations, from which we identified 17 articles for full-text review. Of these nine articles were eligible for inclusion. We excluded the other eight articles because five did not meet the eligibility criteria, one was a review article, 1 was mass screening and 1 was a retrospective analysis. Four articles[67-70] were primary, follow-up and secondary reports on the same study. Therefore, we retrieved the final report on this study from their nominated website and extracted data from it.[73] We additionally identified one article[74] by scanning the references of included studies and by searching for studies that had cited these papers. The study selection process is outlined in Figure 1.1. One study published by Obrador[72] was conducted at two different locations (Mexico City and Jalisco state), and the outcome measures and descriptive data of the participants screened at these locations were reported separately (under one publication). Therefore, we have included these separately in our analysis. The updated search in PubMed identified one relevant study[75], which met the eligibility criteria and was included in the final analysis.

Figure 1.1 Study selection process



1.4.2 Study characteristics

Screening programs were conducted in the United States[71, 73, 76], Iran[74], Canada[51, 75], Australia[36] and Mexico[72]. Five studies [36, 72, 73, 75, 76] were of prospective cohort design and the remaining three[51, 71, 74] were cross-sectional in nature. Most studies were conducted in the past 10 years except the study by Brown et al.[76] which was conducted almost 20 years ago. The number of people at risk who participated in all included studies ranged from 402[36] to 1,50,972[73]. The mean age of participants ranged between 46[72] and 65.3 years[75] across six studies that reported these data. Six studies[71-74, 76] recruited a higher proportion (> 65%) of female participants. The follow-up period across studies ranged from half to three months. The screening programs were conducted in various community settings and utilised a range of healthcare professionals (Table 1.1).

Table 1.1 Characteristics of the included studies

First Author and year	Study design	Risk of bias assessment	Setting	Healthcare Professional Involved	N	Mean Age (SD)	% Female	Follow-up (months)
Brown et al.,[76] 2003	Prospective cohort	Serious	Multiple settings~, United States	Physician	889	NR	67	1 and 3
Harward et al.,[71] 2009	Cross-sectional	Moderate	Multiple settings~, United States	Multidisciplinary*	1,742[#]	54	70.1	NA
Matthew et al.,[36] 2010	Prospective cohort	Moderate	Community venue and company workplace, Australia	Renal nurse or scientist	402	58 (11.1)	47	3
Obrador et al. (a),[72] 2010[+]	Prospective cohort	Moderate	Unclear, Mexico	Multidisciplinary*	519	46 (15)	72	3
Obrador et al. (b),[72] 2010[+]	Prospective cohort	Moderate	Mobile screening units, Mexico	Multidisciplinary*	2,020	53 (13)	74	NR
NKF-KEEP,[73] 2012	Prospective cohort	Moderate	Multiple settings~, United States	Multidisciplinary*	1,50,972	NR	68	Approx. 2
Barahimi et al.,[74] 2014	Cross-sectional	Moderate	Specialised clinics, Iran	Multidisciplinary*	1,228	NR	>70	3

First Author and year	Study design	Risk of bias assessment	Setting	Healthcare Professional Involved	N	Mean Age (SD)	% Female	Follow-up (months)
Al Hamarneh et al.,[51] 2016	Cross-sectional	Moderate	Community pharmacy, Canada	Community pharmacists	720	63`	43	3
Galbraith et al.,[75] 2016	Prospective cohort	Moderate	Multiple settings, Canada	Registered nurse or pharmacist	6329^	58.5 (15.9)	65.3	0.5 to 1

NKF-KEEP National Kidney Foundation's Kidney Early Evaluation Program, *SD* standard deviation, *NR* not reported, *NA* not applicable, *Approx*. approximately; ᵻ Data of the studies Obrador (a) and (b) were presented under one publication; * Physicians, nurses, educators, social workers, research/lab technicians, internists, executive authorities, nephrologists, dietitians and trained volunteers (medical students, nursing students, citizens); ~ Churches, hospitals, health centres, schools, community centers, friendship centers, religious centers, senior's residence, Safeway (supermarket), grocery stores, health center buildings, community colleges, senior citizen centers, correctional institutions and dialysis units; # Data is calculated from participants who completed the questionnaire. Proteinuria was conducted on 1706 participants and MAU on 1497; ^ Data is calculated from all people who participated in the screening event. eGFR was calculated only for 5144 participants who provided complete data; ` median age.

1.4.3 Targeted screening program characteristics

Table 1.2 shows the targeted screening program characteristics, such as CKD risk factors targeted, screening tests used to detect CKD, equations used to calculate renal function and thresholds used for positive screening test results.

1.4.4 CKD risk factors targeted

Screening interventions screened participants with the age of ≥ 18,[71-73, 75, 76] ≥ 20,[36] and > 30[74] years. Risk factors targeted by the screening programs included diabetes[36, 51, 71-76] high blood pressure,[36, 51, 71-76] first-degree relative with diabetes and high blood pressure, [72, 73, 76] vascular disease,[51, 71, 75] high-risk ethnic population (e.g. Aboriginal, Hispanic, South Asian, Asian, or African descent),[36, 75] current tobacco use[51, 75] and high cholesterol level.[51]

1.4.5 Screening tests and thresholds used

Included studies used different screening tests for CKD detection. Four studies[71, 72, 75, 76] included dipstick urinalysis, five[36, 51, 72-74] performed ACR measurement, one[76] used SCr measurement alone and seven[36, 51, 72-75] reported eGFR. All studies[36, 51, 72-76] except one[71] used both kidney damage and kidney function tests for CKD screening. Three studies[73-75] used the Chronic kidney disease-Epidemiology Collaboration (CKD-EPI) formula and four used the Modification of Diet in Renal Disease (MDRD) formula[36, 72, 73] to calculate the eGFR.

The threshold values used for positive screening test results also varied across the screening programs. One study used a proteinuria value of ≥ 150 mg/L,[72] one used a value of ≥ 300 mg/L[71] and one did not report the threshold value used [75]. One study used a MAU value of ≥ 20 mg/L[71] and one [76] did not report the MAU value used. Three studies[72-74] used an ACR value of ≥ 3.4 mg/mmol, one[36] used a value of > 2.5 mg/mmol for male or > 3.5 mg/mmol for female and one used[51] ACR value of ≥ 3 mg/mmol or ≥ 30 mg/mmol. Seven studies[36, 51, 72-75] used an eGFR value of < 60 mL/min/1.73m^2.

Table 1.2 Characteristics of the targeted screening programs

	Brown[76]	Harward[71]	Matthew[36]	Obrador (a)[72 +]	Obrador (b)[72 +]	NKF-KEEP[73]	Barahimi[74]	Al Hamarneh[51]	Galbraith[75]
CKD risk factors targeted									
High blood pressure	•	•	•	•	•	•	•	•	•
Diabetes	•	•	•	•	•	•	•	•	•
Family history of kidney disease	•	•	•	•	•	•		•	•
First degree relative with diabetes	•			•	•	•			
First degree relative with high blood pressure	•			•	•	•			
Vascular disease		•*						•#	•
High-risk ethnic population			•~						•^
Tobacco use								•	•
High cholesterol level								•	
Screening tests used to detect CKD									
Dipstick urinalysis	•	•			•				•
Albumin/creatinine ratio			•	•		•	•	•	
Serum creatinine	•								

	Brown[76]	Harward[71]	Matthew[36]	Obrador (a)[72 +]	Obrador (b)[72 +]	NKF-KEEP[73]	Barahimi[74]	Al Hamarneh[51]	Galbraith[75]
Estimated glomerular filtration rate			•	•	•	•	•	•	•
Equations used to calculate renal function									
MDRD			•	•	•	•		-	
CKD-EPI						•	•	-	•
Thresholds used for positive screening test results									
Microalbuminuria									
Not reported	•								
≥ 20 mg/L		•							
Proteinuria									
Not reported									•
≥ 150 mg/L					•				
≥ 300 mg/L		•							
Albumin/creatinine ratio									
> 3.5 mg/mmol, F; > 2.5 mg/mmol, M			•						
≥ 3 mg/mmol								•	

	Brown[76]	Harward[71]	Matthew[36]	Obrador (a)[72 +]	Obrador (b)[72 +]	NKF-KEEP[73]	Barahimi[74]	Al Hamarneh[51]	Galbraith[75]
≥ 30 mg/mmol								•	
≥ 3.4 mg/mmol				•		•	•		
Serum creatinine									
> 1.2 mg/dL, F; > 1.4 mg/dL, M	•								
Estimated glomerular filtration rate									
< 60 mL/min/1.73m^2			•	•	•	•	•	•	•

NKF-KEEP National Kidney Foundation's Kidney Early Evaluation Program, *CKD* chronic kidney disease, *MDRD* Modification of Diet in Renal Disease, *CKD-EPI* Chronic Kidney Disease Epidemiology Collaboration, *NR* not reported; $^+$ Data of the studies Obrador (a) and (b) were presented under one publication; * Heart disease; # prior diagnosis of cardiovascular disease, stroke, transient ischaemic attack or peripheral vascular disease; ~ Aboriginal; ^ Aboriginal, Hispanic, South Asian, Asian, or African descent.

1.4.6 Outcome measures

A total of 8 studies[36, 71-76] reported the percentage of participants with positive screening results. Figure 1.2 shows the percentage of participants with positive screening test results as per the screening tests and thresholds used to detect. The percentage of participants with positive results of kidney damage were inconsistent and ranged from 11.4%[71] to 60.3%[71] by dipstick test, and 8%[36] to 35%[74] by ACR measurement. The percentage of participants with positive results of a decline in kidney function was 12.8% by SCr measurement and 7%[72] to 26.1%[74] by eGFR.

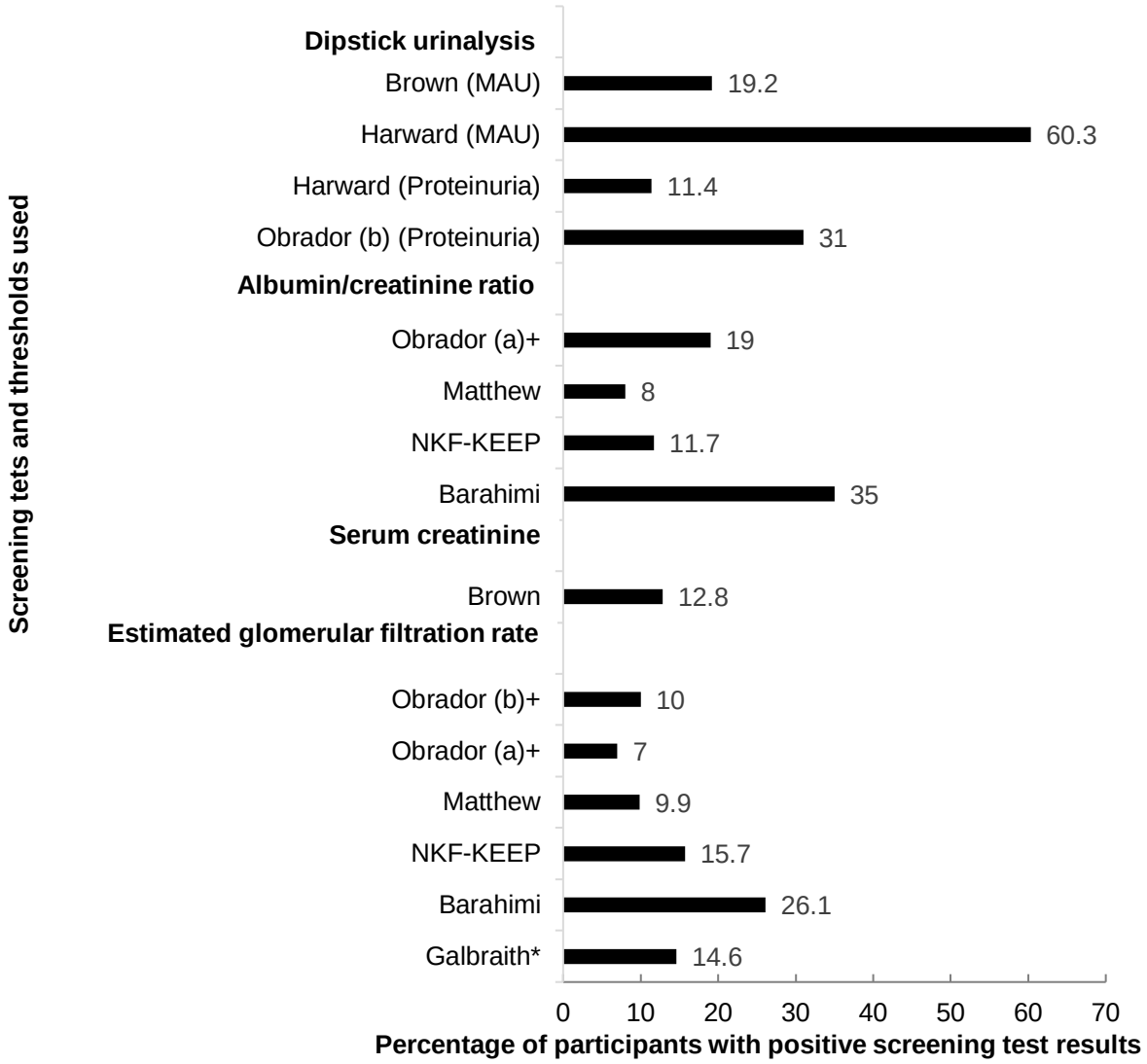


Figure 1.2 Percentage of participants with positive screening test results as per the screening tests and thresholds used to detect CKD.

Studies with data (i.e. percentage of participants with positive screening results) either not reported or unclear are not shown in this figure. *NKF-KEEP* National Kidney Foundation's Kidney Early Evaluation Program. [+] Data of the studies Obrador (a) and (b) were presented under one publication; * Data are calculated after excluding participants with self-reported "kidney problems"

The combined positive screening test results were reported by 4 studies.[36, 51, 74, 76] Figure 1.3 shows the percentage of participants with combined (i.e. kidney damage and kidney function) positive screening test results and CKD diagnosis at follow-up. The percentage ranged from 20.4%[36] to 56%.[74] Al Hamarneh et al.[51] and Brahimi et al.[74] confirmed a diagnosis of CKD in 20.5% and 17.1% of screened participants, respectively. Brown et al.[76] reported a CKD diagnosis in 9 participants at follow-up; however, the overall percentage of this and tests used for diagnosis was unclear.

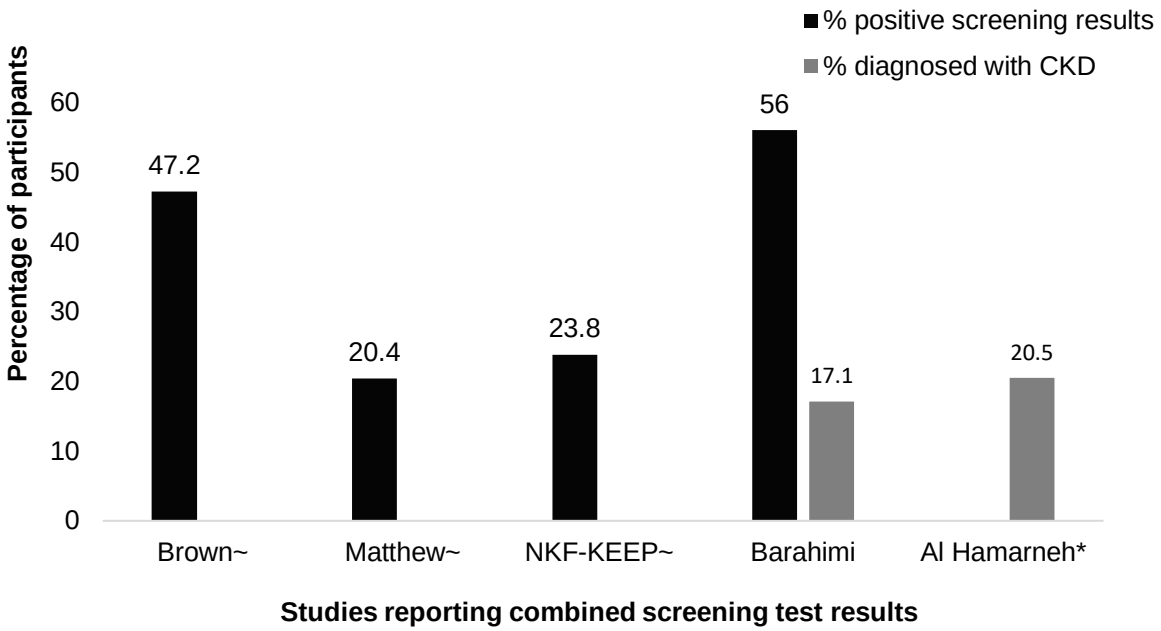


Figure 1.3 Percentage of participants with combined (i.e. kidney damage and kidney function) positive screening test results and CKD diagnosis at follow-up.
NKF-KEEP National Kidney Foundation's Kidney Early Evaluation Program. ~Data on percentage of participants diagnosed with CKD were either unclear or not reported. *Data on percentage of participants with positive screening results were not reported, and data on percentage of participants diagnosed with CKD are calculated after excluding participants with known CKD.

1.4.7 Risk-of-bias within studies

Overall, screening interventions of the included studies were well defined. All studies were at moderate risk of bias due to confounding at pre-intervention stage. Two studies[51, 75] recruited participants with CKD and kidney problems; however, these studies also reported results obtained using statistical analysis that adjusted for these confounding variables. One study[76] was at serious risk of bias due to missing data, and 8 studies[36, 51, 71-75] were at low risk of bias in selection of the reported results. The risk of bias assessment for all studies is shown in Table 1.3.

Table 1.3 Risk-of-bias assessment of studies included in this review

Bias criteria	Brown[76]	Harward[71]	Matthew[36]	Obrador (a)[72 +]	Obrador (b)[72 +]	NKF-KEEP[73]	Barahimi[74]	Al Hamarneh[51]	Galbraith[75]
Bias due to confounding	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Bias in selection of participants into this study	Low	Low	Low	Low	Low	Low	Low	Low	Low
Bias in measurement of interventions	Low	Low	Low	Low	Low	Low	Moderate	Low	Low
Bias due to departures from intended interventions	No information	No Information	No Information	No Information	No Information	No Information	No Information	No Information	No Information
Bias due to missing data	Serious	Low	Low	Low	Low	Moderate	Low	Low	Low
Bias in measurement of outcomes	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

Bias criteria	Brown[76]	Harward[71]	Matthew[36]	Obrador (a)[72] +	Obrador (b)[72] +	NKF-KEEP[73]	Barahimi[74]	Al Hamarneh[51]	Galbraith[75]
Bias in selection of the reported results	Moderate	Low	Low	Low	Low	Low	Low	Low	Low
Overall	Serious	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

NKF-KEEP National Kidney Foundation's Kidney Early Evaluation Program; + Data of the studies Obrador (a) and (b) were presented under one publication.

1.5 Discussion

We identified a broad range of targeted screening interventions that detected a considerable but inconsistent number of people with markers of kidney disease. We found that the screening programs varied with respect to the screening tests and thresholds used to detect CKD. A possible explanation could be the inconsistencies between various guidelines' recommendations for proteinuria, albuminuria, ACR and protein/creatinine ratio (PCR) and diagnostic cut-off values.[63] We also found inconsistencies in the percentage of participants with positive screening results. This is most likely because studies that had higher positive screening results of dipstick test, i.e. 31% and 60.3%, used lower threshold values of proteinuria (≥ 150 mg/L)[72] and MAU (≥ 20 mg/L),[71] respectively. Dipstick tests are well known as the most feasible method for screening in community settings, although there is evidence that "false positive" and "false negative" results are quite common.[79, 80] Albuminuria can be transient or persistent and positive results of the dipstick tests should be confirmed by quantitative laboratory measurements, such as ACR or PCR, for diagnostic evaluation.[80] We found that none of the screening programs that used the dipstick method evaluated or reported the CKD diagnosis at follow-up. Hence, no conclusions could be made about the validity of this method for targeted screening.

Another possible explanation for inconsistencies is the participant eligibility criteria. The age cut-off for the study[74] with the highest test result (i.e. 35%) by the eGFR measurement was > 30 years whereas other studies screened participants who were ≥ 18 years[72, 73, 75, 76] and ≥ 20 years.[36] Moreover, the study with the highest test result looked at participants only with a personal history of diabetes and hypertension. The remaining studies included a broader range of participants, such as first-degree relative with diabetes, hypertension or kidney disease, vascular diseases, high-risk ethnic population, current tobacco user and high cholesterol level,

which may have resulted in the lower percentage of participants with positive screening test results.

Screening interventions conducted more recently used the CKD-EPI formula[51, 73-75] whereas older studies used the MDRD formula.[36, 72, 73] This could be because the CKD-EPI equation is associated with lower false positives and is more accurate in estimating eGFR between 60 and 120 mL/min/1.73m^2.[81] However, it is important to note that both equations have limitations because the results are normalised to the body surface area of 1.73 m^2, and the lack of representation of racial and ethnic minorities in the development or validation of the equations.[82, 83] Also, both equations use serum creatinine which is influenced by muscle mass, diet, medications and unstable co-morbid conditions. Hence, it is important to view each participant's result as an estimate and not an actual GFR.

Two[51, 74] studies reported CKD diagnosis rate of 20.5% and 17.1% by 2 consecutive ACR and eGFR measurements over a period of 3 months. However, the participants screened in the Canadian study[51] were recruited from another randomised controlled study of pharmacist-led cardiovascular risk reduction intervention, suggesting that these participants were at higher risk when compared with other participants of the included studies. Nevertheless, these data suggest that even with a robust healthcare system in place, it is likely that a significant proportion of patients at risk are not being routinely monitored for CKD.

The Kidney Disease Improving Global Outcomes (KDIGO) 2012 clinical practice guideline for the Evaluation and Management of CKD clearly states that a person needs to have persistence of either decreased kidney function (eGFR < 60 mL/min/1.73m^2) or kidney damage (ACR > 3 mg/mmol) for at least three months for a diagnosis of CKD.[4] Hence, a systematic approach for initial detection of CKD is essential, which means repeating diagnostic evaluation of both ACR and eGFR, two to three times over the next several months before a person can be labelled as having CKD.[80] A recent cross-sectional study found false-positive results in

67.5% of participants with mild proteinuria. In case of absence of proof of chronicity of a decreased eGFR, a false positivity of 32% with stage 3A and 7.4% participants with stage 3B CKD was found. Repeated measurements for confirmation of proteinuria and chronicity of eGFR (conducted after a period of 3, 6 and 12 months) resulted in an almost 50% decrease in the CKD prevalence.[84] This data suggests that there is a very high risk of CKD over-diagnosis, when diagnostic tests are not repeated. Many studies[36, 71-73, 75, 76] included in this review reported results only from the one-time tests that were performed during the intervention, and participant follow-up data were either not evaluated or reported. Similarly, Bruck et al. found that none of the studies conducted to determine the prevalence of CKD in the general population had evaluated the chronicity of eGFR and/or albuminuria.[85]

Most[36, 72-76] screening programs used simultaneous testing (i.e. measurements of both kidney damage and decline in kidney function) to detect CKD; however, all defined CKD stages 3 and above, based on eGFR alone. The current CKD classification used by KDIGO is based on both eGFR and albuminuria category. The use of albuminuria together with eGFR has been shown to greatly enhance the ability to detect and quantify the risk of progressive CKD, particularly at CKD stage 3 or above.[86] On the other hand, the use of eGFR alone to categorise CKD stage 3 has been shown to cause false positive categorisation and over-diagnosis in as many as 30% of people.[87] Labelling several people as having CKD without diagnostic confirmation and appropriate CKD staging, increases the chances of over-diagnosis and further negates the benefit of screening in the targeted population.

A major issue with observational studies is the potential for confounding bias. Confounding is most likely to occur due to the presence of existing co-morbidities other than those being recorded during the intervention and participants' awareness of his/her previous diagnosis of CKD. Although the included studies controlled for confounding by restricting the eligibility of participants based on known CKD risk factors, these were generally self-reported. Bias in the

implementation of screening programs in community settings can also occur as participants who agree to undergo screening are likely to be volunteers, more educated and health-conscious individuals.[88]

1.6 Conclusion

Our analysis shows that a considerable percentage of participants are being identified with CKD by targeted screening. However, data on the percentage of participants for whom follow-up was successful and who were diagnosed with CKD at follow-up, as well as data on loss to follow-up, were either unclear or not reported in many studies. Hence, it is difficult to draw definitive conclusions on the effectiveness of targeted screening. We recommend that future studies should be designed such that follow-up of screened participants is conducted and reported at regular intervals to allow interpretation of the effectiveness of screening programs. Furthermore, screening programs should use simultaneous testing approaches, and CKD should be classified using both eGFR and albuminuria categories. This will help prevent over-diagnosis and labelling the healthy as diseased in the community.

Preface

Chapter 2 has been published in the 'International Journal of Clinical Pharmacy' under the title "A web-based training program to support chronic kidney disease screening by community pharmacists" (Volume 38, Issue 5, Pages 1080-1086). The authors of this publication include: Pankti A. Gheewala, Gregory M. Peterson, Syed Tabish R. Zaidi, Luke Bereznicki, Matthew D. Jose and Ronald L. Castelino. This article was first available online on 23rd June 2016 and its DOI is 10.1007/s11096-016-0330-5. The impact factor of this journal is 1.555. The published paper presented under Chapter 1 has been re-formatted to maintain consistency with the rest of the thesis.

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Expected presentation date	Jan 2018
Portions	Full article
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PROJECT II (A)

CHAPTER 2. A Web-based Training Program to Support Chronic Kidney Disease Screening by Community Pharmacists

2.1Abstract

2.1.1 Background

Owing to the increase in the global health burden of CKD, community pharmacists' role in the early CKD detection and prevention could be beneficial. Hence, a web-based training program was developed to enhance community pharmacists' abilities to perform a CKD risk assessment service in community pharmacy settings. The aim of this study was to evaluate the impact of a web-based training program on pharmacists' knowledge and skills associated with CKD risk assessment. As a secondary measure, pharmacists' satisfaction with the training program was assessed.

2.1.2 Methods

A web-based training program was developed by academic pharmacists and a nephrologist. Quantitative data were collected by employing a self-administered, web-based questionnaire, which comprised a set of five multiple-choice knowledge questions and one clinical vignette to assess skills. A nine-item Likert scale was used to determine pharmacists' satisfaction with the training program. The outcome measures were (1) Pharmacists' knowledge and skills scores at pre- and post-training, (2) Reliability of the Likert scale, and (3) Proportion of responses to the individual nine items of the satisfaction survey.

2.1.3 Results

Fifty pharmacists participated in the pre-questionnaire and 38 pharmacists completed the web-based training and post-questionnaire. Significant differences were observed in the knowledge scores ($p < 0.001$) and skills scores ($p < 0.001$) at pre- and post-training. Cronbach's alpha for the nine-item satisfaction scale was 0.73, and the majority of pharmacists (92.1% - 100%) were satisfied with the various aspects of the training program.

2.1.4 Conclusion

The web-based training program positively enhanced pharmacists' knowledge and skills associated with CKD risk assessment. These findings support further development and widespread implementation of the training program to facilitate health promotion and early identification of CKD in a community setting.

2.2 Introduction

Community pharmacists are commonly presented with patients who are on several medications for the management of their chronic diseases. Given their training and accessibility, community pharmacists are well placed to play a key role in providing health promotion and screening services to the general population.[89] In Australia, pharmacists have successfully implemented, within their normal daily practice, many interventional programs such as for asthma management,[90] home-based post discharge warfarin management,[91] detecting and resolving drug-related problems,[92] and CVD risk screening.[44] The delivery of these high-quality and evidence-based interventions provides pharmacists with an opportunity to improve overall consumer health outcomes.[93]

Evidence suggests that early identification and management of CKD has enormous potential to prevent or delay the disease progression and associated adverse outcomes, such as kidney failure, CVD and premature death.[15] Numerous guidelines recommend regular screening of patients with established risk factors such as hypertension, diabetes, CVD and a family history of kidney disease, particularly as in the majority of patients with early stage CKD (Stages 1-3), the progression is asymptomatic.[63]

Community pharmacists' potential to improve the quality use of medications in patients with CKD has been widely explored. Also, pharmacists' interventions in patients with CKD, improved management of blood pressure and lipid profile, and reduced all-cause hospitalisations and the incidence of ESKD or death.[94] So far, no quantitative study has been performed to investigate the role of community pharmacists in early CKD detection and prevention. Only a qualitative analysis identified the need for pharmacists to participate in continuing education workshops on 'early CKD detection', and increase public awareness of CKD.[95]

The aim of this study was to develop a web-based training program and evaluate its impact on community pharmacists' knowledge and skills associated with a CKD risk assessment service. As a secondary measure, pharmacists' satisfaction with the training program was assessed.

2.3 Methods

This study was approved by the Tasmanian Health and Medical Human Research Ethics Committee, University of Tasmania (H0014258).

Four pharmacists (RC, TZ, GP, and LB) and a nephrologist (MJ) designed and developed the 60-minute web-based training program. The learning objectives were to: (a) demonstrate knowledge on CKD and renally cleared medications; (b) effectively identify from the general population people with risk factors of developing CKD; (c) demonstrate skills for the effective performance of the CKD risk assessment calculator;[55] (d) provide suitable counselling to high risk patients on lifestyle management of CKD; and (e) critically review the medication regimen of high risk patients for prescribing of renally cleared medications. The program (delivered by PG) comprised a lecture presentation (Appendix 2.1) on CKD topics, including: (a) incidence and economic burden; (b) complications, risk factors and primary causes; (c) diagnosis and management; (d) quality use of medications in patients with CKD (including drugs that require dosage adjustment or are contraindicated in renal impairment); and (e) a case presentation on how to conduct an early CKD detection service using a risk assessment calculator.[55] The web-based training program was reviewed and pre-tested by clinical experts. Following this, revisions were made in the lecture presentation before final implementation.

The CKD risk assessment calculator is a predictive algorithm developed to identify patients at increased risk of developing moderate-severe kidney disease over the next five years. The algorithm uses risk predictors including age, gender, ethnicity, body mass index, systolic blood pressure, smoking status, and clinical conditions (such as Type 1 diabetes, Type 2 diabetes,

CVD, treated hypertension, congestive heart failure, peripheral vascular disease, rheumatoid arthritis, systemic lupus erythematous, kidney stones and family history of kidney disease), to calculate a patient's percentage risk of developing kidney disease. This calculator thus allows pharmacists to perform risk stratification in community patients and enable identification of those patients who need further diagnostic testing and regular monitoring of their kidneys.

A web-based questionnaire was used to evaluate the impact of the training program on pharmacists' knowledge and skills. A thorough literature search identified no existing questionnaire to evaluate pharmacists' CKD screening abilities. Therefore, we reviewed questionnaires developed for pharmacist-led interventions in CKD management and quality use of renally cleared medications.[96-98] We also searched for studies that evaluated the impact of continuing education or training programs on pharmacists' knowledge for other diseases.[99-101] We subsequently developed a questionnaire for evaluation of the training program (for use pre- and post-training). Knowledge was evaluated by a set of five multiple-choice questions, and skills were evaluated by a clinical vignette (Appendix 2.2). The self-administered questionnaires were designed using LimeSurvey (Version 2.05+) and responses were kept anonymous. The multiple-choice questions were about general concepts on CKD such as CKD complications; renal function markers; renally excreted drugs; CKD signs and symptoms; and CKD risk factors. Correct responses were given a score of 1 and incorrect responses were given a score of 0. Subsequently, a total score for individual pharmacists and mean total score were calculated. For the clinical vignette, pharmacists had to determine the patient's five-year risk of developing CKD using the risk assessment calculator.[55] Pharmacists did not have access to the calculator at pre-training. During the training, pharmacists were shown how to use the risk assessment calculator and at post-training, all pharmacists had access to the calculator. The percentage of pharmacists with correct responses to individual multiple-choice questions and

the clinical vignette was also calculated. Both questionnaires included a section capturing the demographic and professional characteristics of the community pharmacists.

At the end of the training, pharmacists were asked to complete an online satisfaction survey (Appendix 2.3) to assess their reaction towards the various aspects of the training program. The survey was generated by identifying similar articles[97, 102, 103] and utilising Donald Kirkpatrick's Level 1-Learner satisfaction model.[104] This nine-item survey included statements where pharmacists indicated their level of agreement with the program on a five-point Likert scale of (1) 'Agree Strongly' to (5) 'Disagree Strongly'. Two open-ended questions were also designed to provide pharmacists with an opportunity to express their own thoughts on the CKD training program. The multiple-choice questions, clinical vignette and satisfaction survey were peer-reviewed by two experts and trialled on academic pharmacists.

A letter of invitation explaining the purpose of the study (along with the information sheet and consent forms) were mailed to all (a total of 143) community pharmacies across Tasmania (Appendix 2.4, 2.5, 2.6, 2.7). To further encourage participation, all pharmacies received a telephone invitation after a period of 14 days. Pharmacists who agreed to participate in the study were required to complete the pre-training questionnaire. Two reminder phone calls were also made at 2-weekly intervals in order to increase the response rate. Subsequently, pharmacists (who had completed the pre-questionnaire) were sent web links for the training program and post-questionnaire. Follow-up telephone calls were made at an interval of 2 and 4 weeks as a reminder to complete the training. Pharmacists who had not completed the post-questionnaire after the phone calls were considered non-respondents.

Statistical Package for the Social Sciences (SPSS) version 22.0 was used for the analysis. Descriptive statistics were used to characterise demographic and professional details of the community pharmacists. The Shapiro-Wilk test was used to determine normality and for

subsequent selection of the statistical tests. Responses to the web-based questionnaire were non-identifiable and therefore, the Mann-Whitney U test was used to compare differences between the pre- and post-responses of the pharmacists. A p value < 0.05 was considered statistically significant. Reliability of the satisfaction survey was assessed using the Cronbach's alpha measure. The percentage of responses for each Likert scale category was calculated. Both open-ended questions were analysed by employing a thematic approach and similar categories were then eliminated.

2.4 Results

A total of 50 pharmacists from 27 community pharmacies (response rate 19%) agreed to participate and were recruited into the study. Twelve pharmacists who completed the pre-questionnaire withdrew from the study due to time constraints and major business transitions occurring at the pharmacy. Overall, 38 pharmacists completed the training program and post-questionnaire.

Table 2.1 describes the demographic and professional characteristics of community pharmacists who participated in the pre- and post-training questionnaire. The proportion of community pharmacists across age groups was similar. Twenty-six percent of the pre-sample and 15.8% of the post-sample had undertaken the accreditation process to provide medicines review services.

Table 2.1 Demographic and professional characteristics of community pharmacists who participated in the pre- and post-training questionnaire.

Characteristics	Pre-training		Post-training	
	N	%	N	%
Total	**50**	**100**	**38**	**100**
Age group (years)				
20-29	14	28	12	31.6
30-39	9	18	6	15.8
40-49	14	28	11	28.9
>=50	13	26	9	23.7
Gender				
Male	24	48	17	44.7
Female	26	52	21	55.3
Community pharmacy experience (years)				
<=5	15	30	12	31.6
6-10	7	14	5	13.2
11-15	4	8	4	10.5
16-20	4	8	3	7.9
21-29	13	26	9	23.7
>30	7	14	5	13.2
Highest educational qualification				
Undergraduate	39	78	30	78.9
Honours	5	10	4	10.5
Masters	5	10	3	7.9
Doctorate	1	2	1	2.6
Home Medicines Review* Accreditation				
No	37	74	32	84.2
Yes	13	26	6	15.8

*A Home Medicines Review is a comprehensive clinical review of a patient's medicines in their home by an accredited pharmacist on referral from the patient's general practitioner.

Knowledge and skills scores of the pharmacists at post-training were statistically significantly higher than the same at pre-training (p<0.001, using Mann-Whitney U test). As shown in Table 2.2, the median (IQR) knowledge score was 4 (3-4) at pre-training and 4 (4-5) at post-training. The median (IQR) skills score was 0 (0-0) at pre-training and 1 (0-1) at post-training.

Table 2.2 Knowledge and skills scores of pharmacists, pre and post-training.

Scores		Pre-training	Post-training	*p*-value
Knowledge	Mean (SD)	3.56 (0.812)	4.29 (0.835)	< 0.001
	Median (IQR)	4 (3-4)	4 (4-5)	
Skills	Mean (SD)	0.08 (0.274)	0.61 (0.495)	< 0.001
	Median (IQR)	0 (0-0)	1 (0-1)	

Figure 2.1 shows pre- and post-training percentage of community pharmacists with correct responses to the individual knowledge questions and clinical vignette. Responses to two questions showed significant improvements following training: the signs and symptoms that can occur in patients with CKD (pre, 34% vs. post, 58%) and drugs excreted via the renal system (pre, 58% vs. post, 87%). Pharmacists' skills (assessed via the clinical vignette) to appropriately use the risk assessment calculator also improved at post-training (pre, 8% vs. post, 60.5%).

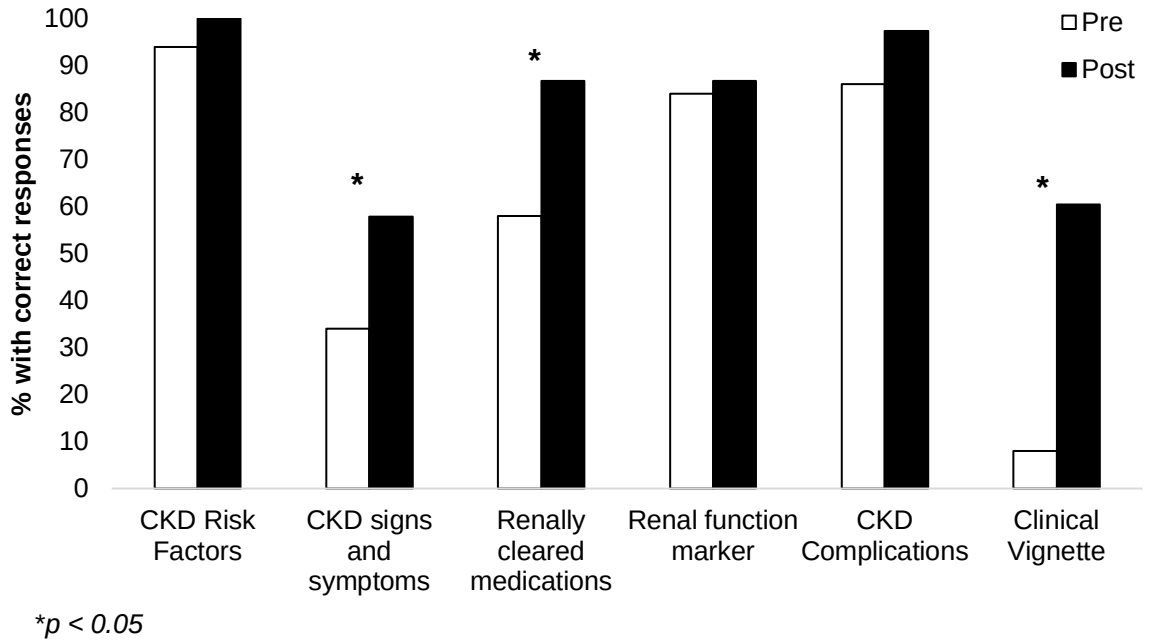


Figure 2.1 Pre- and post-training percentage of community pharmacists with correct responses to the individual knowledge questions and clinical vignette

Cronbach's alpha for the nine-item satisfaction survey was 0.73, suggesting that the scale had good internal consistency. Table 2.3 shows the percentage of pharmacists rating the web-based training program as "Agree strongly" or "Agree somewhat". The majority of pharmacists agreed that the objectives of the training were met, the program content was organised and easy to follow, the program content was relevant to them, and the lecturer had good knowledge with respect to the training topic.

Table 2.3 Percentage of pharmacists rating the individual nine-items of the satisfaction survey as 'Agree strongly' or 'Agree somewhat' (n = 38).

Survey Item	Agree strongly (%)	Agree somewhat (%)	Cumulative (%)
Objectives of the training program were clearly defined	84.2	15.8	100
The content was organised and easy to follow	68.4	31.6	100
Content of the training program was relevant to me	84.2	15.8	100
Time allocated for the training program was sufficient	57.9	34.2	92.1
This training experience will be useful in my work	60.5	36.8	97.4
This training program further motivated me to participate in the study	52.6	42.1	94.7
Learning objectives of the training program were met	60.5	36.8	97.4
The lecturer has good knowledge with respect to the training topic	81.6	18.4	100
The lecturer communicated information clearly	71.1	26.3	97.4

Four key themes identified from the analysis of the two open-ended questions were: clarity, conciseness, convenience and relevance to the pharmacist. Based on the responses, it was determined that the pharmacists were generally satisfied with the web-based delivery of the training program. The majority of pharmacists liked that the content and structure of the program were clear and succinct. They found the web-based strategy to be highly convenient and accessible:

'The training program could be completed on-line, at a time and place that suits me'.

Pharmacists also considered this as an opportunity to utilise their professional expertise in terms of CKD screening:

'Information provided was very educational. The program raised awareness on the significance of CKD and promotes the professional importance that pharmacists could have in the community.'

'Good recap on kidney disease. Also, identified potential for pharmacists to be more involved in potential diagnosis and disease state awareness.'

2.5 Discussion

With the rising need to decrease the societal burden, high morbidity and mortality associated with CKD, detection of CKD in its early stages is vital.[88] Community pharmacists' role in the prevention and management of diseases such as asthma, CVD, diabetes, and hypertension is well established.[89] However, our literature search could not identify any study that used community pharmacies as a resource for early identification and prevention of CKD. Therefore, prior to determining the feasibility of implementing CKD screening services within Australian community pharmacy practice, it was essential to evaluate pharmacists' knowledge of CKD and their ability to screen patients for CKD. This was investigated in the current study.

Results of this training program revealed that community pharmacists had overall good knowledge of CKD risk factors, complications and renal function markers. Their knowledge on CKD signs and symptoms and renally cleared medications was comparatively low, which increased notably as a result of the training. Findings of this study further reveal significant improvement in pharmacists' skills to appropriately use the risk assessment calculator. However, future training programs should consider implementing more than one clinical vignette to further reinforce learning outcomes.

It is evident from responses of the satisfaction survey that a majority of pharmacists found the web-based strategy highly convenient as it allowed them to participate and complete the training in their own time over a period of two to four weeks. For community pharmacies which employ only one pharmacist, it becomes difficult to attend a training program at a designated

venue, particularly if based in a remote or rural area.[105] Hence, a web-based approach would be highly beneficial and allow pharmacists ease of access for several evidence-based education and training programs.

One of the limitations of this study was that the responses to both questionnaires were kept anonymous and non-identifiable. As a result, we could not match the pre-responses of a particular pharmacist to their post-responses. Nevertheless, there were no significant differences observed between the two groups in terms of demographics, qualifications and professional experience. Although the number of participants in our study was low, they had reasonably diverse demographic profiles. Therefore, our findings are likely to be significant for similar web-based training programs when implemented in a larger population of community pharmacists. Finally, future studies could consider periodic reassessment to determine how long the pharmacists retain their increased knowledge and skills.

2.6 Conclusion

Overall, the pharmacists had a relatively low level of knowledge and skills associated with CKD screening, indicating a need for training in order to improve their CKD screening abilities. Positive results of this study support further development and widespread implementation of this training program, as this has the potential to create awareness and facilitate early identification of CKD in a community setting. However, a larger study is needed to evaluate the long-term feasibility and cost-effectiveness of this training program when implemented in a community pharmacy setting.

PROJECT II (B)

CHAPTER 3. Evaluation of A Chronic Kidney Disease Risk Assessment Service in Community Pharmacies

3.1 Abstract

3.1.1 Background

Targeted 'opportunistic' screening might be a sustainable approach for the early detection of people with undiagnosed CKD. The aim of this study was to implement and evaluate a CKD risk assessment service in the community pharmacy setting.

3.1.2 Methods

Twenty-four pharmacies in Tasmania, Australia participated in this study. Targeted people were aged between 50-74 years, with CKD risk factors (at least one of hypertension, diabetes, heart failure, obesity, smoker, history of heart attack, angina, stroke or transient ischaemic attack, or family history of kidney disease). The QKidney® risk calculator was used to estimate the targeted peoples' five-year percentage risk of developing moderate-severe CKD. People identified with ≥ 3% risk were referred to their general practitioner (GP) and followed-up after nine months. Each individual's risk assessment result was sent to their GP. Laboratory data were later collected (with participant consent) from a pathology provider. The main outcome measures were rates of GP referral uptake and of participants who underwent eGFR and ACR measurement.

3.1.3 Results

We analysed 389 participants, of whom 203 (52.1%) had ≥ 3% 5-year risk of developing moderate-severe CKD and were referred to their GP. Follow-up was successful for 126 participants and showed low (27%) GP referral uptake. GPs not initiating discussion on the risk assessment results was identified as a major contributor to the low referral uptake. Analysis of the pathology data revealed suboptimal kidney testing in participants with ≥ 3% risk, with eGFR and ACR tests performed for only 52.7% and 25.1% of these participants, respectively. Also, simultaneous (eGFR + ACR) testing and repeated analysis for abnormal results was performed for only 19.7% and 13.3%, respectively.

3.1.4 Conclusion

There is significant scope for improving public awareness and early detection of CKD via implementation of a community pharmacy-based CKD risk assessment service. However, a healthcare system that encourages a close working relationship between community pharmacists and GPs, and provides a robust referral pathway to ensure participant follow-up is needed to improve the effectiveness of this service.

3.2 Introduction

A systematic analysis indicated that about 497 million adults worldwide in 2010 had CKD, the burden of which is fuelled by the epidemics of diabetes and hypertension.[1] CKD is a major risk factor for end-stage kidney disease (ESKD), CVD and premature death.[9] In Australia, data on the prevalence of CKD are limited and the best available evidence to estimate the CKD burden is drawn from renal replacement therapy (RRT) data.[30] At the end of 2014, 959 Australians per million population were undergoing RRT,[30] and 17% of new patients were referred late to nephrologists for the management of ESKD.[17] A retrospective study found that despite the increasing prevalence of CKD in the state of Tasmania, Australia, testing for kidney disease (i.e. SCr and albuminuria) in at-risk people was suboptimal.[34] This indicates significant evidence-practice gaps and the need to improve early CKD detection.

Early diagnosis and treatment of CKD has the potential to reduce the risks of CVD and CKD progression by up to 50%.[5, 6] Worldwide, many targeted screening programs for CKD have been conducted[106] and an Australian screening program 'Kidney Evaluation for You (KEY)' found that targeted 'opportunistic' screening might prove to be a sustainable approach.[36] Community pharmacy-based screening or risk assessment services have shown potential in detecting people at high risk of diabetes and CVD.[42, 44, 53, 90] Additionally, pharmacy-based screening and health promotion services help to increase public awareness. Pharmacists are highly accessible and in a good position to engage people within the community who are not aware of their risks and less likely to access general practice care.[48] Hence, pharmacists could play an important role in the early detection, referral and education of individuals at risk of CKD.

Current literature indicates that various risk assessment tools[56, 57, 59, 60, 65] can facilitate the early identification of people at risk of developing CKD. One such validated tool recommended

by Kidney Health Australia (KHA) is the QKidney® risk calculator.[55, 56, 58, 61] This algorithm, which estimates a person's risk of developing moderate-severe CKD (eGFR < 45mL/min/1.73m^2) over the next five years, was derived using the data of over 1.5 million primary care patients from 188 general practices across England and Wales.[58]

The main aim of this study was to implement and evaluate a CKD risk assessment service, using this tool, in Tasmanian community pharmacies. Specific objectives were to (i) identify people at risk of developing moderate-severe CKD over the next five years and refer them to their general practitioner (GP) for further evaluation, and (ii) document the challenges of implementing a CKD risk assessment service within community pharmacy.

3.3 Methods

The Tasmanian Health and Medical Human Research Ethics Committee (H0014258) approved this prospective cohort study. Written informed consent was obtained from all participants in this study.

Between February 2015 and March 2016, we conducted this study at 24 Tasmanian community pharmacies. As per the Pharmacy Access/Remoteness Index of Australia (PHARIA), 14 pharmacies were located in highly accessible areas (Category 1, Index 0 – 1), eight were located in accessible areas (Category 2-3, Index >1 – 4), and two were located in moderately accessible areas (Category 4, Index >4 – 6).[107] Geographically, 13 pharmacies were located in the south, five were located in the north/north east, and six were located in the north west/west of Tasmania. Prior to implementing the CKD risk assessment service, participating community pharmacists were provided with online training, and their skills and knowledge associated with CKD risk assessment were evaluated. This has been described in detail within Project II (A).[108] Trained community pharmacists (n = 38), final-year pharmacy students (n = 2) and a researcher (n = 1) conducted this study. Pharmacists received an incentive of

$15/participant recruited (funding was provided by the Tasmanian Community Fund). Patient participation was promoted via posters (Appendix 3.1) placed in the pharmacies and by pharmacists, directly approaching eligible individuals arriving at the community pharmacy.

3.3.1 Risk assessment service

Individuals eligible to participate were aged between 50-74 years, with at least one of the following self-reported risk factors: high blood pressure (BP) requiring treatment, diabetes, heart failure (HF), obesity (BMI $\geq$ 30 kg/m^2), current smoker, personal history of heart attack, angina, stroke or transient ischaemic stroke (TIA), or family history of kidney disease. Participants who self-reported having CKD were excluded. The flow diagram for the risk assessment protocol is shown in Appendix 3.2. After written consent was obtained, an assessment data form was used to collect participant details such as demographic characteristics (age, gender, ethnicity, address, contact number), GP details, clinical information (smoking status, medical history, family history), and medication history (prescription and over the counter (OTC) drugs, complementary and alternative medicine (CAM)). Participants were asked to wait for at least 5 minutes before their sitting BP was measured using an electronic sphygmomanometer. The first systolic BP reading was recorded and classified as per the guidelines for the diagnosis and management of hypertension in adults by the National Heart Foundation of Australia.[109] Individual participants' height and weight were measured; subsequently, the calculated BMI was recorded and classified.[110] All supporting documents used to conduct the CKD risk assessment service are shown under Appendix 3.

Collected information was entered into the online QKidney® risk calculator (version 2014 and 2016).[55] Participants were given a detailed explanation of their risk assessment result, written education material on kidney disease (Appendix 3.10), and a copy of their results sheet.

As per the KHA recommendations,[111] participants identified with < 3% "low" risk were not referred; participants with 3-15% "moderate" risk were encouraged to discuss the results with their GP at the next planned visit; and participants with > 15% "severe" risk were asked to discuss the results with their GP within the next two weeks. We also sent a letter to the GP (Appendix 3.11) for each participant identified with ≥ 3% risk; the letter included information on the study, and a copy of the individual participant's assessment data form and results sheet.

3.3.2 Participant follow-up

All participants with ≥ 3% risk were followed up by telephone after 9 months. We made three attempts to contact the participant by telephone, after which we sent the survey via post. The survey included questions to establish whether the participant had: a) discussed their risk assessment results with their GP and b) undergone a 'Kidney Health Check'. According to KHA, a 'Kidney Health Check' consists of three tests: blood test for eGFR, urine test for ACR, and BP measurement.[5] The survey also included questions to determine if participants had made any changes to their lifestyle and disease management strategies as a result of participation in this study.

3.3.3 Pathology data collection

Written informed consent was obtained from all participants at the beginning of the study to collect their laboratory data on eGFR and ACR. These data were collected from a major Tasmanian community-based pathology laboratory. Participant data on laboratory tests performed within one year after undergoing the risk assessment and repeated within 3 months of initial tests for participants with evidence of CKD were included in the final analysis. The pathology provider calculated the eGFR by using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) formula as per the revised recommendations of the Australasian

Creatinine Consensus Working Group.[112] Evidence of CKD was defined as an eGFR <60 mL/min/1.73m^2 and ACR >3.5 mg/mmol, female or >2.5 mg/mmol, male.[6]

3.3.4 Sample size calculation

Based on the data presented in research that developed and validated the risk assessment calculator,[58] and extrapolating to an older cohort of individuals with at least one pre-existing risk factor for CKD, we estimated that 50% of the sample would have a 5-year risk of moderate-severe CKD of at least 3% (and therefore require referral). Using a 5% precision and 99% confidence level (to be 99% sure that the true percentage of the population aged between 50 and 74 years with at least one CKD risk factor that has a 5-year risk of moderate-severe CKD of at least 3% using the risk assessment calculator, is between 45% and 55%) we needed 384 eligible individuals.

3.3.5 Statistical analysis

We used the Statistical Package for Social Sciences (SPSS) version 23.0 software to perform statistical analysis. Participants with 3-15% moderate-risk were sub-categorised into 3-7.9% moderate-risk 1 and 8-15% moderate-risk 2. Descriptive statistics were calculated as mean and standard deviation (SD) for continuous variables, and percentage for categorical variables. We used a thematic approach to analyse all answers to the open-ended questions.

3.4 Results

3.4.1 Withdrawal of community pharmacists

Fourteen of 38 pharmacists withdrew from the study and the most common reason reported for withdrawal was lack of time and staff. Several pharmacists mentioned that being the only pharmacist on-duty, they were too busy to spend 10-15 minutes per participant to conduct the risk assessment effectively.

3.4.2 Risk assessment service

Out of 405 participants initially recruited in the study, we excluded 16 participants because either they did not meet the eligibility criteria or we received their data after the follow-up timeline had passed. Table 3.1 shows the demographic and clinical characteristics of the 389 participants included in the final analysis. The mean (± SD) age of participants was 63.3 (± 6.4) years and 50.4% were female. More than half of our sample had two or more risk factors for CKD. Most participants (81.2%) had hypertension, 21.9% had type 2 diabetes, 15.9% had a history of heart attack, angina, stroke or TIA, and 6.7% had an immediate family history of kidney disease. Of the sample, 14.2% were smokers and 45.2% were obese. More than half of the sample (51.7%) were using CAMs, and the most common were vitamin D (21.0%), fish oil (15.5%), and magnesium (7.5%); 32.1% were using OTC drugs, and paracetamol (70.7%) was the most common of these.

Table 3.1 Participant demographics and clinical characteristics

Characteristics	N	%
Total	**389**	**100**
Mean age (mean ± S.D.., range)	63.3 ± 6.4, 50-74	
Gender		
Female	196	50.4
Male	193	49.6
Ethnicity		
White or not stated	383	98.5
Indian	1	0.3
Other Asian	2	0.5
Other ethnic group	3	0.8
Region (n = 381)		
South	205	52.7
North/north east	89	22.9
North west/west	87	22.4
Smoking status		
Non-smoker	218	56.0
Ex-smoker	116	29.8
Light smoker (fewer than 10 cigarettes/day)	29	7.5
Moderate smoker (10 to 19 cigarettes/day)	11	2.8
Heavy smoker (20 or more cigarettes/day)	15	3.9
Diabetes		
Type 1	5	1.3
Type 2	85	21.9
Heart failure	9	2.3
High blood pressure requiring treatment	316	81.2
History of a heart attack, angina, stroke or transient ischaemic attack	62	15.9
Immediate family* history of kidney disease (*mother, father, brothers or sisters)	26	6.7

Characteristics		N	%
Total		**389**	**100**
Body mass index (kg/m^2)			
Underweight	<18.5	2	0.5
Healthy	18.5-24.9	56	14.4
Overweight	25-29.9	155	39.8
Obese	≥30	176	45.2
Systolic blood pressure (mmHg) (n = 386)			
Optimal	<120	50	12.9
Normal	120-129	51	13.1
High normal	130-139	113	29.0
Grade 1 (mild) hypertension	140-159	128	32.9
Grade 2 (moderate) hypertension	160-179	38	9.8
Grade 3 (severe) hypertension	≥180	6	1.5
Qkidney risk range (%)			
Risk category	**Percentage risk**		
Low	<3	186	47.8
Moderate 1	3-7.9	130	33.4
Moderate 2	8-15	45	11.6
Severe	>15	28	7.2

The online QKidney® risk calculator identified 47.8% participants at “low” risk (< 3%), 33.4% at “moderate” risk 1 (3-7.9%), 11.6% at “moderate” risk 2 (8-15%), and 7.2% at “severe” risk (> 15%) of developing CKD in the next 5 years. Almost half (44.6%) of participants had a systolic BP ≥140 mmHg (as measured during risk assessment); 47.8% and 30.6% of participants with and without a reported diagnosis of hypertension, respectively, had a systolic BP ≥140mmHg.

3.4.3 Participant follow-up

Of 203 participants with ≥ 3% risk, 28 were excluded from the follow-up analysis because 12 had forgotten participating in the study, 8 had missing address/contact details and 8 withdrew during follow-up. From the remaining 175 participants, follow-up was successful for 126 (72%). The rate of successful follow-up was similar across moderate-risk 1 (71.4%), moderate-risk 2 (74.4%) and severe-risk (70.8%) categories. The success rate was highest (75.6%) amongst participants between 60-69 years and lowest (60.7%) for the age group 50-59 years. Most (70.6%) participants reported that they became aware of the risk assessment service after being approached by a pharmacist for participation.

Of 126 participants with successful follow-up, 120 (95.2%) had subsequently visited their GP and 34 (27.0%) had discussed their results. Of participants (n = 41) who provided reasons for no discussion of the results, 34% mentioned that their GP did not initiate discussion on the risk assessment results and, therefore, they did not.

Of 34 participants with follow-up who had discussed results with the GP, blood test, urine test and BP check were performed for 26, 17 and 17 participants, respectively. The percentage of participants who underwent a complete 'Kidney Health Check' was 9 (26.5%). During follow-up, 36.4% of participants with hypertension (n = 110) and 48.1% of participants with diabetes (n = 54) agreed that they were prompted to take better care of their hypertension and diabetes, respectively, as a result of participation. Of 14 participants with follow-up who were smokers at the time of risk assessment, 7 reported reducing the number of cigarettes smoked per day and 1 had stopped smoking.

3.4.4 Pathology data analysis

Within one year following risk assessment, eGFR and ACR testing was performed in 52.7% (n = 107) and 25.1% (n = 51), respectively, of ≥ 3% risk participants (n = 203). Simultaneous

eGFR and ACR tests were performed for 19.7% (n = 40) participants. Table 3.2 shows the stratification of participants' eGFR and ACR data as per their moderate-severe risk categories.

Six participants in the moderate-risk 1 category and one in the moderate-risk 2 category had eGFR between 45-59 mL/min/1.73m^2; however, repeated eGFR testing was performed for only one participant who was under the moderate-risk 1 category. Five, two and one participants in the moderate-risk 1, moderate-risk 2 and severe-risk category, respectively, had an ACR between 3.5-35 mg/mmol, female and 2.5-25 mg/mmol, male. Again, repeated ACR testing was performed for a single participant who was in the severe-risk category.

Table 3.2 Stratification of participants' estimated glomerular filtration rate and albumin creatinine ratio data as per their moderate-severe risk categories

			Risk categories					
	Total		Moderate-risk 1 (3-7.9%)		Moderate-risk 2 (8-15%)		Severe-risk (> 15%)	
	N	%	N	%	N	%	N	%
Estimated glomerular filtration rate (mL/min/1.73m2) (n = 107)								
>90	36	33.6	22	61.1	10	27.8	4	11.1
60-89	64	59.8	40	62.5	14	21.9	10	15.6
45-59	7	6.5	6	85.7	1	14.3	-	-
30-44	-	-	-	-	-	-	-	-
15-30	-	-	-	-	-	-	-	-
<15	-	-	-	-	-	-	-	-
Albumin creatinine ratio (mg/mmol) (n = 51)								
<3.5, female; <2.5, male	43	84.3	26	60.5	9	20.9	8	18.6
3.5-35, female; 2.5-25, male	8	15.7	5	62.5	2	25	1	12.5
>35, female; >25, male	-		-	-	-	-	-	-

3.5 Discussion

The community pharmacy-based CKD risk assessment service, with its targeting, identified a high proportion (52.2%) of people at ≥ 3% risk of developing moderate-severe CKD within 5 years. However, the follow-up analysis revealed that a low proportion (27%) of referred participants had discussed their risk results with their GP. The major reason for the low referral uptake was GPs not initiating discussion on the risk assessment results. Also, absence of an existing medical complaint might have contributed to participants' reluctance to initiate discussion.[40] Another contributing factor towards the low referral uptake could be the manner in which the results were communicated to the GP. All GPs were sent a referral letter; however, it is possible that not all of them had the opportunity to read it before the patient visit.[113] On the other hand, GPs might not have agreed with the recommendations of the risk assessment and chose not to act or deferred investigation in participants who were already overwhelmed with their existing comorbidities. Also, GPs might have over-relied on their patients to initiate discussion on the risk results.[114] In any case, the low referral uptake was a major hindrance to the efficacy of the CKD risk assessment service.

No previous studies have implemented a similar protocol in community pharmacies for CKD; hence, direct comparisons could not be made. Upon literature review, we found many pharmacy-based screening studies for diabetes,[41, 43, 115] asthma,[116, 117], bowel symptoms,[118] CVD[44] and atrial fibrillation[113], which concluded that screening in community pharmacy is effective and feasible. However, this seems to have been overstated because the GP referral uptake reported in the majority of these studies[41, 43, 113, 115, 116, 118] was low and ranged from 9.1-49%. Only two studies[44, 117] reported a high GP referral uptake (92-83%), although the rate of referral uptake was self-reported by participants in one study[117] and participant loss to follow-up in another study was high (>50%).[44] A recent systematic review investigating the effectiveness of pharmacy-based screening services found a significant proportion of screened participants do not attend their GPs for follow-up, or GPs often do not act on the referral

information.[48] Additionally, a qualitative study of Australian GPs showed that most did not favour pharmacists' provision of screening services, as they believed screening to be the role of the GP and lacked confidence in the accuracy of screening tests and pharmacists' competence.[119] These findings suggest that any pharmacy-based screening services, even with a robust in-pharmacy protocol, are likely to have a low success rate unless there are close working relationships between community pharmacists and GPs.[120-122] More specifically, there is a need to develop an innovative referral pathway which can ensure that patients who have undergone screening at community pharmacies are subjected to further investigation during their routine visit to the GP.[119, 122]

A distinctive aspect of our study, compared with other pharmacy-based screening studies, was the availability of participant pathology results. The QKidney® algorithm calculates a person's risk of developing moderate-severe CKD over the next five years; however, this study identified 15 participants who had evidence of early CKD. For an accurate CKD diagnosis, the KHA-CARI guidelines on early CKD detection recommend simultaneous and repeated ACR and eGFR measurement; otherwise, an increased incidence of both over- and under-diagnosis is likely.[6, 51, 123] Our pathology analysis showed that simultaneous testing was performed in only 19.7% of ≥ 3% risk participants and, although more than half of these participants had undergone eGFR testing, only above one-quarter had their ACR measured. Similarly, in 2007, Jose *et al.* found that only 50.6% and 9.4% of at-risk Tasmanians had serum creatinine and albuminuria measured, respectively.[34] Also, our study found that repeated ACR or eGFR measurement within three months of initial testing was performed for only 2 (13.3%) out of 15 participants with initial evidence of CKD. This suboptimal kidney testing might be attributed to the significant gaps, as identified by the AusHEART study, in Australian GPs' adherence to preventative guidelines and recognition of CKD.[12]

Our pathology analysis revealed that more than half of ≥ 3% risk participants had undergone kidney testing (either eGFR or ACR measurement); however, only few were aware of it. Similarly, the AusDiab study found relatively low recollection of kidney testing even in patients with CKD.[124] This suggests that information sharing by providing pharmacists access to patients' medical records and pathology data would help to prevent unnecessary screening,[51] as well as enabling pharmacist review of medication dosing in kidney disease.

There are two community-based pathology providers in the state of Tasmania. The pathology provider from which the data for this study were collected owns approximately 80% of the Tasmanian pathology specimen collection centres and has been operating for approximately 50 years whereas the other provider has been operating only for the past three years. However, it is possible that relevant pathology data for some participants may be missing.

In this study, BP measurement was performed only once. This approach was used because the CKD risk assessment protocol was relatively time-consuming as it included several components. Generally, community pharmacists do not have more than 10 minutes to spare to perform such interventions. Similarly, pharmacy customers won't generally participate in these interventions unless they are brief. Repeating the blood pressure measurements would have increased the overall protocol time by at least 5 minutes. Hence, pharmacists were advised to take a single sitting blood pressure reading but only after ensuring that the participant was properly rested.

Several barriers restricted pharmacists from continuing participation. Future studies should aim to reduce the time required to conduct risk assessment. If pharmacy assistants are trained to a) collect participant demographic and clinical data, and b) measure height and weight, then this would allow the pharmacists to focus on key aspects, which include 1) BP measurement,

2) risk assessment and 3) CKD education. Pharmacists would then need only 5-10 minutes/participant. Lastly, it is possible that kidney testing by the GP was performed as a result of other ongoing comorbidities and not as an outcome of risk assessment.

3.6 Conclusion

This study showed considerable scope for improving the awareness and early detection of CKD via implementation of a community pharmacy-based CKD risk assessment service. In order to improve the referral uptake, we recommend that during CKD risk assessment, community pharmacists should put emphasis on the asymptomatic nature of CKD and explain to the participant the importance of consulting their GP for a regular 'Kidney Health Check'. On the other hand, a healthcare system that encourages a close working relationship between pharmacists and GPs is needed if pharmacy-based risk assessment and screening services are to benefit the public.

PROJECT II (C)

CHAPTER 4. Community Pharmacists' Experience of Implementing A Chronic Kidney Disease Risk Assessment Service.

4.1 Abstract

4.1.1 Background

Community pharmacists are well positioned to deliver chronic kidney disease (CKD) screening services. However, little is known about the challenges faced by pharmacists during service implementation. The main objective of this study was to explore community pharmacists' experience and barriers of implementing a CKD risk assessment service.

4.1.2 Methods

Pharmacists who had implemented a CKD screening service were eligible to participate. A purposeful sampling strategy was used for the selection of pharmacists with maximum variation. A conventional content analysis approach was used to conduct the qualitative study. Data collection was performed using semi-structured, open-ended interview questions. Transcripts were thematically analysed. The consolidated criteria for reporting qualitative research (COREQ) were followed.

4.1.3 Results

Five broad themes emerged from the analysis: contextual fit within community pharmacy; perceived scope of pharmacy practice; customer perception towards disease prevention; CKD – an underestimated disease; and remuneration for a beneficial service. Pharmacists found the

CKD service to be efficient, user-friendly and of significant benefit to their customers. However, several pharmacists observed that their customers lacked interest in disease prevention, and had limited understanding of CKD. More importantly, pharmacists perceived the scope of pharmacy practice to be significantly dependent on inter-professional collaboration between pharmacists and general practitioners (GPs), and customer acknowledgement of pharmacists' role in disease prevention.

4.1.4 Conclusion

Overall, community pharmacists perceived the CKD service to be worth incorporating within pharmacy practice. To increase uptake, future CKD services should aim to improve customer awareness about CKD prior to providing risk assessment. Further research investigating strategies to enhance GP involvement in pharmacist-initiated disease prevention services is also needed.

4.2 Introduction

In Australia and elsewhere, the economic and health burden associated with chronic kidney disease (CKD) is high.[13] Data from Australia's dialysis and transplant registry show that the prevalence of patients undergoing renal replacement therapies is steadily increasingly;[30] this is largely fuelled by the ageing population, and rising rates of diabetes and hypertension.[1, 17] Evidence suggests that early diagnosis of CKD allows implementation of preventive measures that can reduce the risks of CKD progression and associated cardiovascular disease (CVD) by up to 50%.[125] Despite this evidence, the availability of clinical practice guidelines,[4, 6] and development of risk stratification tools,[57, 58, 60, 65] numerous people in the community with early stages of CKD remain undetected.[11] CKD among Australian older adults within primary care settings is also common, and under-recognised and under-treated.[12] This indicates a large gap in clinical practice, and the need to explore ways through which early detection of CKD can be improved.

Screening targeted groups of people with established CKD risk factors was identified as an important strategy for early CKD detection.[6] Thus, several community-based targeted screening programs were conducted;[36, 51, 71-75] however, most programs lacked methodological rigour and long-term feasibility.[106] Instead, implementation of targeted 'opportunistic' screening within the healthcare system was identified as a more practical and effective approach.[11, 12, 36] 'Opportunistic' screening occurs when a check or test is offered to an individual, without symptoms of CKD, when they present to a healthcare system for other reasons.[11]

Currently, in Australia, routine screening for CKD is not practised.[11] Involving community pharmacists in the early detection of CKD could be beneficial.[126] In recent years, the role of pharmacists has extended to the provision of disease prevention services, with patient benefit at the core of these services.[127, 128] Furthermore, pharmacy screening for diseases such as

diabetes,[41-43] osteoporosis,[45, 46] CVD[44] and atrial fibrillation[47] has shown potential. Similarly, a community pharmacist-initiated targeted CKD risk assessment service could help to alert general practitioners (GPs) of at-risk patients who need further diagnostic evaluation. Hence, we implemented and evaluated a CKD risk assessment service within 24 community pharmacies in the state of Tasmania, Australia.

To further understand the feasibility of the CKD service, we conducted follow-up qualitative research to explore the pharmacists' experience of implementing this service, with a focus on identifying the barriers to service implementation.

4.3 Methods

4.3.1 Ethical approval

The Tasmanian Social Sciences Human Research Ethics Committee (H0015669) approved this study.

4.3.2 CKD risk assessment service

Prior to implementing the CKD service, online training was provided to participating pharmacists, and their skills and knowledge associated with CKD risk assessment were evaluated.[108] Eligible customers were aged between 50-74 years, with at least one of the following risk factors: high blood pressure (BP), diabetes, heart failure, obesity (BMI $\geq$ 30 kg/m^2), current smoker, personal history of heart attack, angina, stroke or transient ischaemic attack, or family history of kidney disease. The online QKidney® risk calculator,[55, 56, 58] which estimates a person's 5-year risk of developing moderate-severe CKD, was used by the participating pharmacists to identify participants with $\geq$ 3% risk; these individuals were counselled on the results, given educational materials and advised to consult their GP for further assessment. These participants were followed-up after 9 months and their laboratory data were collected (with consent) from a pathology provider to determine the percentage of

participants who underwent estimated glomerular filtration rate (eGFR) and urine albumin creatinine ratio (ACR) measurement. Follow-up data analysis showed relatively low GP referral uptake (27%), and pathology analysis revealed suboptimal kidney testing in 80% of ≥ 3% risk participants.

4.3.3 Study design and participant selection

Initially, the purpose and design of the study was explained to the pharmacists by researchers via mail and/or telephone. Written informed consent was obtained from all 24 pharmacists prior to the service implementation. After the intervention, a researcher PG (PhD candidate) approached the 8 pharmacists by telephone to organise the face-to-face qualitative interview. Pharmacists were selected by purposeful sampling strategy, to provide variation in age and geographic location.[129] No pharmacists refused to participate in the qualitative interview.

4.3.4 Data collection

A conventional approach for content analysis was used to perform the qualitative research.[130] A semi-structured, in-depth interview was conducted with individual pharmacists at their respective community pharmacy, four months after completion of the intervention. Interview questions were directly related to the study objectives and open-ended (Table 4.1). Prompts were also offered to the pharmacists where open-ended questions elicited little response. All interviews were audio-recorded and lasted between 15-45 minutes.

Table 4.1 Interview guide for pharmacists

Would you please describe your daily role as a community pharmacist? Could you please tell me the demographics of most of the customers that present to your pharmacy? Do you have a doctor's surgery nearby?
What do you think is the current role of community pharmacists in providing health promotion, risk assessment and screening services?
What did you think about the chronic kidney disease risk assessment study? Follow-up questions: -What did you like most about this service? -Was there any aspect of this service that you didn't like? -Was there any aspect you thought could be improved?
According to you, is the QKidney risk assessment calculator feasible or useful in a community pharmacy setting?
What was it like to recruit participants for this study? Follow-up questions: -What strategy did you use to recruit participants? -How did you find the recruitment process? -Did you find it difficult or easy to recruit participants? -Could you give me examples of few reasons that participants used for declining to participate in this study?
How did your participants respond to this risk assessment service? Did they seem interested? Did your participants know what chronic kidney disease is before participation? Follow-up questions: -What did your patients think about it? -What was their reaction? -Did they come back asking about it? -Have you received any feedback from participants?
Did you have your own target in mind that you would recruit at least say X number of participants for this study and were you able to accomplish your target?

Follow-up questions: -What prevented you from achieving your target?
What do you think stops people in the community from participating in a pharmacist-led chronic kidney disease risk assessment service?
Do you think people in the community need a chronic kidney disease risk assessment service?
Have you had any feedback from a general practitioner or a nurse with regards to the CKD risk assessment service?
Overall, would you consider the chronic kidney disease risk assessment service to be a success? Why? Follow-up question -I am curious to know whether you would be willing to offer this service in your community pharmacy if you had a choice.
Finally, if there was anything that you would have changed or done differently when it comes to implementing similar research projects in your community pharmacy in future, what or how would you do it? Thank you once again for participating in this study.

4.3.5 Data analysis

The QSR International's NVivo 11 software program was used to support each phase of the qualitative data analysis. All audio-recordings were transcribed verbatim into Microsoft Word documents by Digitype Australasia (a specialist legal and medico-legal transcription service) or the author PG, and imported into NVivo. The general inductive approach[131] was used to identify themes in the documents. The analysis commenced by reading the transcripts several times. Initially, a list of free nodes (data categories) was generated and document contents were coded exhaustively into relevant nodes. These nodes were then re-grouped and organised hierarchically into trees to establish highly conceptualised themes. Initial coding of the raw data was performed by PG, with a subsequent discussion with a second author (STZ) to reach

an agreement on the themes. These themes were then applied back to the original data. The research team met again to further refine the themes, which were reviewed against the original transcripts. Feedback from the participants on the results of the analysis was not obtained. The consolidated criteria for reporting qualitative research (COREQ) were followed.[132]

4.4 Results

A total of 8 pharmacists were interviewed and data saturation was met. Table 4.2 summarises the pharmacists' characteristics. Five major themes emerged from the analysis: contextual fit within community pharmacy; perceived scope of pharmacy practice; customer perception towards disease prevention; CKD – an underestimated disease; and remuneration for a beneficial service.

Table 4.2 Characteristics of the interviewed pharmacists

Pharmacist no.	Age group	Gender	Years worked as a community pharmacist	Pharmacy location*	No. of participants recruited
P1	56-65	Male	11-15	S	>30
P2	36-45	Male	5-10	S	10-20
P3	56-65	Female	>20	N/NE	<10
P4	26-35	Female	<5	N/NE	>30
P5	36-45	Male	5-10	S	<10
P6	26-35	Female	<5	S	<10
P7	46-55	Female	16-20	NW/WW	<10
P8	46-55	Male	>20	NW/WW	<10

*Location of the pharmacy in the state of Tasmania is described geographically.

S south; N/NE north/north east; NW/WW north west/western wilderness

Contextual fit within community pharmacy

This theme was defined as the appropriateness of providing the CKD risk assessment service within the context of community pharmacy practice as perceived by the pharmacists.

Most pharmacists in this study agreed that the CKD risk assessment was a well-designed and straightforward service that could be incorporated into their routine practice.

> "I thought that it was a good idea as a screening. You know it was nice and simple to go through with the patients. It didn't take too long." (P5)

Additionally, pharmacists identified the online risk assessment calculator as a user-friendly tool. They liked that the online calculator required minimum data that could be easily obtained from participants, and provided results immediately.

> "I think it's definitely a good tool to have and it doesn't exactly take very long, so it's not like it would take that much time out of your day to do a quick check." (P4)

Most pharmacists mentioned that the customers who underwent risk assessment appreciated the service.

> "Any of them that clipped up (were identified with ≥ 3% risk), they were in the doctors straightaway… and they thought that was good… it was just really positively received by all the participants." (P3)

However, several pharmacists mentioned that, given the nature of a community pharmacy business, at times it was challenging to recruit participants and carry out risk assessment. Being the sole pharmacist on duty or having a busy pharmacy prohibited pharmacists from performing risk assessment.

"Our time was little bit tricky to squeeze it in. Trying to come out and approach patients about this service and that was a little bit of a barrier I guess than trying to fit it between prescriptions." (P2)

Some pharmacists reported that the paperwork required too much time and thinking; and further suggested streamlining or computerising the entire process.

"I think it could be quite easily streamlined so that it becomes easy to do but it does need to be a real, simple process for the pharmacist…" (P3)

Several pharmacists found that training staff members to identify eligible customers, recruit and perform the initial stages of the risk assessment, was a useful approach to reduce their burden.

"… As soon as we started teaching the staff members, you know make sure that you ask them this, then it became a lot easier." (P4)

Perceived scope of pharmacy practice

As perceived by pharmacists, the continuing scope of pharmacy practice (especially in the provision of disease prevention services) was found to be highly dependent on the inter-professional collaboration between pharmacists and GPs, and customers' acknowledgement of the role of pharmacist in disease prevention. Pharmacists reported difficulty in engaging GPs as a key barrier to the perceived effectiveness of the CKD service. At the beginning of the study, a brief discussion on the CKD service occurred between several pharmacists and GPs. At that time, pharmacists received mixed reactions; some GPs had a positive view towards risk assessment while others did not actively participate. However, most pharmacists said that they did not receive any feedback from the GPs, and some wanted to know the outcome of GP

referral. Pharmacists expressed that although they can provide such services, having GPs on board was crucial. GPs were considered as the final decision makers in the care of patients; without their support, pharmacists believed that the scope of the CKD service was limited.

> "We did communicate that (CKD service) to them (GPs) briefly but you know they're very busy. They didn't take it on board as a big deal." (P2)

Several pharmacists felt that their professional standing in disease prevention was still undervalued, with their customers generally not perceiving this as a role for pharmacists.

> "I think this is an area still to be developed. I am not sure that in a general community our credentials as screening people have been developed or promoted… to the point for people (to) actually see us as being preventative provider." (P8)

However, integration of the CKD service with other established pharmacy services, for which pharmacists have credibility (e.g. medications review and diabetes management), was found to improve the service uptake.

> "What I did is your kidney study was there and then diabetes study we started in the pharmacy, so we linked both together and that has been better. So the same person, we can sometimes do the both studies." (P1)

Additionally, to encourage customer participation, some pharmacists used flyers or newsletters (other than the promotional poster), and invested more time in directly approaching and explaining the service to eligible customers.

> "We went okay once we like started going out and really putting posters up and that sort of thing." (P4)

Several pharmacists stated that large-scale promotion through the media could help to create awareness and improve the uptake of pharmacy services.

> "It's probably the fact that we don't have ads on the radio saying go into pharmacy for this and the other… that's the thing that makes people realise what your scope of business is." (P7)

Customer perception towards disease prevention

Pharmacists stated that customers were often unwilling to participate, mainly due to their lack of interest in disease prevention.

> "… the people who I thought would be good to do really didn't – they weren't interested. They didn't have time for their health basically. They weren't worried enough about it." (P3)

Pharmacists also found it difficult to engage customers for participation.

> "… A lot of the time they (customers) will come in and they are busy… So they will be like aw I have only got enough time to get my scripts while I am here. Even though someone could be doing it while they were waiting for the script. But they don't seem to see to both of them together. They just go nope can't do it, I don't have enough time…." (P6)

CKD – an underestimated disease

It was frequently identified that limited CKD awareness campaigns might have contributed towards the reduced uptake of the CKD service. Pharmacists perceived CKD to be an important, yet often ignored chronic disease in the community. They mentioned that, compared to other diseases, such as diabetes, hypertension or CVD, CKD and its screening is not promoted on a large-scale within the community.

> "I think diabetes screening is actually more prominent simply because of the fact that there is more funding behind it and Diabetes Tasmania tends to promote it reasonably well in terms of people getting screened. So again it's probably an awareness thing I think that they have more awareness than kidney function possibly does." (P8)

Additionally, pharmacists found that their customers had limited understanding of CKD and functions of the kidneys. Due to the lack of any symptoms, customers believed that their kidneys were fine; hence, they did not see the need to undergo risk assessment.

> "They didn't think it was something you know they needed to look out or they felt fine at that particular moment, so why would they worry about what their kidneys were doing?" (P7)

Remuneration for a beneficial service

Pharmacists perceived the CKD service to be of significant benefit to their customers. They found that the service helped to raise the participant awareness about the kidneys and improved their understanding of CKD.

> "I think the questions (of CKD service) actually (helped) awaken people to the possibility that (kidneys) could actually be having influence on their life. A lot of people don't necessarily realise that […] they are likely to have or develop kidney problems… I think knowing […] the likelihood of that sort of outcome (CKD) is actually useful information once they (patients) have realised the importance of it." (P8)

Several pharmacists mentioned that they would like to be remunerated for providing the CKD service; especially if it was to become an essential component of the pharmacy business.

One pharmacist stressed that if the service was funded, then they would be able to allocate more of their own and their staff's time to it.

> "There had to be some sort of remuneration… so it makes it (CKD service) worth the time… At the end of the day, we have to run a business and pay for staff so to be able to prioritise time for those different jobs you need to have some sort of income for it."(P7)

4.5 Discussion

Overall, the community pharmacists believed that the CKD risk assessment service was worth incorporating within pharmacy practice. Pharmacists perceived that the service would be of benefit to their customers and important to raise CKD awareness within the community. However, during service implementation, pharmacists experienced several challenges, out of which difficulty in engaging GPs was identified as a crucial barrier to the long-term feasibility of the service. It is well-recognised that inter-professional collaboration between pharmacists and GPs is vital for complete patient care. However, even after initial discussion on the CKD service between some of the pharmacists and GPs, the overall GP engagement was minimal. One reason could be the extent and mode of discussion that took place between the pharmacists and GPs.[119] Another reason could be the lack of GPs' confidence in pharmacists' clinical expertise and capabilities to perform screening services.[119, 120] Conversely, a study found that GPs were generally supportive of those pharmacy services which they found useful in managing patients.[119] Prior to implementation, it is important that pharmacists demonstrate professional expertise to the GPs, explain the benefits of the CKD service, and establish mutual understanding on the referral method.[120, 133]

Another barrier towards service implementation was the limited customer perception of pharmacists' scope of practice. Previous studies exploring the customer opinion of community pharmacy practice found that most customers viewed dispensing as the primary or only role of community pharmacists, and were unaware that pharmacies can offer various public health

services.[114, 134-138] A systematic review examining customer attitudes found that consumers were more receptive towards the availability of medicine-related, rather than health promotion or screening, services from community pharmacy.[127] Therefore, one important strategy to encourage participation in the CKD service would be to incorporate it with other established services, which are commonly used by customers. In this study, pharmacists observed an improvement in the customers' response to the CKD service when it was integrated with services such as medications review or diabetes management. A similar strategy was recommended for future implementation of pharmacy screening services in an atrial fibrillation screening study.[139]

Another effective strategy would be active participation from pharmacists in offering the CKD service. Previous studies have expressed that, in order to improve customer awareness and participation in various pharmacy services, pharmacists need to reassess their daily practice and ensure that they are not just dispensing prescriptions.[138-140] Instead, pharmacists should play an active role by directly approaching customers and explaining available services, and using prominent flyers.[139] Similar strategies were used by pharmacists in this study to improve the CKD service implementation.

This study identified limited customer understanding of CKD and kidneys as a potential barrier towards the service uptake. A study exploring how the public decides to undergo health checks for CVD prevention found that the decision depends on their perception of being vulnerable to the disease and whether they have had any symptoms.[141] Similarly, lack of symptoms was identified as a barrier towards the CKD service uptake. CKD can be asymptomatic until the kidney function declines by up to 90%,[11] and lack of this knowledge puts a person at increased risk of delayed diagnosis. Hence, providing customers with information on CKD, before offering risk assessment, might improve their understanding and make them more receptive towards the service.

Customers and GPs were not interviewed in this study. Exploring their perceptions of the CKD service may help to identify additional barriers, and addressing these could help the pharmacists in enhancing the service implementation. Additionally, a small number of pharmacists were interviewed in this study; however, it is well-known that for studies with a relatively homogenous sample population and narrow objectives, interviews as low as six are sufficient to reach saturation, with meaningful themes and valuable interpretation.[142]

4.6 Conclusion

Pharmacists perceived the CKD risk assessment service to be feasible for implementation within community pharmacy practice. To encourage customer participation, pharmacists should play an active role in promoting and delivering the CKD service. Also, the CKD service should aim to improve customer awareness about CKD prior to offering risk assessment. Widespread implementation of this service has the potential to improve the understanding of CKD within the community, which could lead to enhanced early CKD detection and prevention. However, further research exploring effective strategies to enhance GP involvement in pharmacist-initiated disease prevention services is needed.

PROJECT II (D)

CHAPTER 5. Patient satisfaction with a chronic kidney disease risk assessment service in community pharmacies

5.1 Abstract

5.1.1 Background

Screening services for some chronic diseases are increasingly being implemented in community pharmacy settings. Patient satisfaction is an important determinant of the feasibility and sustainability of these services. However, few studies have evaluated this, with no such study performed for a chronic kidney disease (CKD) risk assessment service. Therefore, the main aim of this study was to determine patient satisfaction with a CKD risk assessment service performed in community pharmacies in the state of Tasmania, Australia.

5.1.2 Methods

An anonymous nine-item satisfaction survey, with Likert-type scales, was developed following a literature review of existing surveys. Patients were asked an additional question on willingness to pay, with choices of amount from AUD $5 to $25. The satisfaction survey was mailed to all 389 patients who participated in the CKD risk assessment study. The main outcome measures were: reliability of the nine-item scale; the percentage of responses to the individual nine items of the satisfaction survey; and patient willingness to pay for the CKD service.

5.1.3 Results

Responses from 143 participants (effective response rate of 42%) were included in the final analysis. The mean (± SD) age of participants was 63.3 (± 6.5) years and 54.5% were female. Cronbach's alpha for the nine-item satisfaction scale was 0.87. The majority of participants agreed that the time required to undergo the risk assessment process was justified (90.2%); overall, they were satisfied with the CKD risk assessment service (90.0%) and they felt comfortable with the pharmacist referring their results to their doctor (88.9%). Of 136 participants who answered the question on willingness to pay, 62.9% indicated that they would pay for the CKD service. Of these, 29.2%, 25.8% and 19.1% were willing to pay $20, $10 and $5, respectively.

5.1.4 Conclusion

Patient satisfaction with the community pharmacy-based CKD risk assessment service was high. These findings provide support for the implementation of the CKD service within community pharmacy practice.

5.2 Introduction

In recent years, there has been a noteworthy increase in the number of community pharmacy-based screening interventions for some chronic diseases.[42-47, 143, 144] However, data on patient satisfaction with such interventions are limited.[145] Patient satisfaction is an important determinant of the feasibility and sustainability of community pharmacy services.[146, 147] Moreover, the degree of patient satisfaction is an essential indicator of the quality of pharmacy services, and highlights service attributes that may need further reassessment and improvement.[146] Patient feedback also allows community pharmacists to self-evaluate their competence to deliver these services.

In Australia, 1 in 10 adults have clinical evidence of chronic kidney disease (CKD) such as reduced kidney function and/or albuminuria.[3] Interestingly, less than 10% are aware that they have this condition. CKD is asymptomatic until kidney function deteriorates by approximately 90%; this puts a person at an increased risk of kidney failure and death.[11] Early diagnosis and treatment of CKD in its initial stages (1-3) has the potential to prevent or delay the progression of CKD,[6] and reduce the likelihood of hospitalisation and mortality.[62] Therefore, Kidney Health Australia's Caring for Australasians with Renal Impairment (KHA-CARI) guideline on 'Early CKD: Detection, prevention and management' recommends screening of people with CKD risk factors.[6]

Although it has been established that targeted screening may help to reduce the burden of CKD,[6] no similar strategies within the Australian healthcare model have been explored. Therefore, we implemented and evaluated a CKD risk assessment service in the community pharmacy setting. Prior to implementation, community pharmacists were trained to deliver the CKD service.[108] The CKD service was subsequently implemented at 24 pharmacies in the state of Tasmania, Australia. Eligible participants were aged between 50-74 years, with at least one

of the following CKD risk factors: hypertension, diabetes, heart failure, obesity, current smoker, personal history of heart attack, angina, stroke or transient ischaemic attack (TIA), or family history of kidney disease.

A total of 389 participants underwent CKD risk assessment during 12 months. An online QKidney® risk calculator was used to estimate individual participant's 5-year percentage risk of developing moderate-severe CKD.[58] Individual participants' height, weight and blood pressure (BP) were also measured during risk assessment. At the end of risk assessment, all participants were given written educational material on CKD, a brief explanation on their risk assessment results, and a copy of their results sheet. Individual risk assessment took approximately 15-20 minutes. Participants identified with ≥ 3% risk (n = 203) of developing moderate-severe CKD were advised to consult their general practitioner (GP) for further assessment, and followed-up after nine months to determine the outcome of GP referral.

To our knowledge, this is the first Australian study to implement a CKD risk assessment service in the community pharmacy setting. Hence, it was important to seek patient perceptions on the CKD service. The aim of this study was therefore to determine patient satisfaction with the CKD risk assessment service within a community pharmacy setting. The specific objectives were to identify CKD service attributes which need further improvement, and establish patients' willingness to pay for the CKD service.

5.3 Method

A nine-item satisfaction scale (Appendix 4.1), developed by three pharmacists, a nephrologist and a researcher, was used to evaluate patient satisfaction with the in-pharmacy CKD risk assessment service. A thorough literature search identified one study that evaluated patient satisfaction with pharmacy-based screening services.[145] Therefore, we identified and reviewed scales that were used for other pharmacy services, such as disease management.[148-152]

Subsequently, we developed a nine-item satisfaction scale, informed by the literature. A six-point Likert-type scale (1 ‘strongly disagree’ to 6 ‘strongly agree’) was used to record responses to individual items. The survey included an additional question on willingness to pay, providing choices of amount from AUD $5 to $25. Participant opinion of the CKD service was also determined via an open-ended question “Are there any comments you would like to make regarding the CKD risk assessment service?” at the end of the survey.

Written consent for participation in the satisfaction survey was obtained from all participants prior to risk assessment within the pharmacies. During telephone follow-up, 13 participants were identified who had forgotten participating in the study. These participants were excluded and the satisfaction survey was sent to the remaining 376 participants by mail. Each envelope contained an invitation letter, the satisfaction survey and a reply-paid envelope. The invitation letter also included brief information on the CKD risk assessment study and the individual participant’s risk results, as a reminder. Responses were anonymous. Participants did not receive any incentive for completing the satisfaction survey. This study was approved by the Tasmanian Health and Medical Human Research Ethics Committee (H0014258).

Statistical Package for the Social Sciences (SPSS) version 23.0 was used for the analysis. Descriptive statistics were calculated as mean and standard deviation (SD) for continuous variables, and percentage for categorical variables. The Shapiro-Wilk test was used to determine normality and for subsequent selection of the statistical tests. The percentage of responses for each Likert scale category was calculated. The open-ended question was analysed by employing a thematic approach and similar categories were eliminated. Cronbach’s alpha was used to determine the reliability of the nine-item Likert scale, using responses to individual Likert scale categories. Next, the Likert scale categories ‘strongly disagree’, ‘disagree’, ‘somewhat disagree’ and ‘somewhat agree’ were grouped as 0; and ‘agree’ and ‘strongly agree’ were grouped as 1. Chi-square test of independence was then used to explore the relationship

between participant characteristics and grouped Likert scale categories. Additionally, the relationship between willingness to pay and participant characteristics was evaluated. A p value of <0.05 was considered statistically significant.

5.4 Results

Of 376 participants, 26 had moved or were uncontactable and 8 withdrew. Hence, the overall response rate (146/342) was 42.7%. In addition, 3 were excluded due to unclear responses. Thus, a total of 143 participants (41.8%) were included in the final analysis, and Table 5.1 summarises their characteristics. The mean (± SD) age was 63.3 (± 6.5) years and 54.5% were female. More than 70% of participants had two or more risk factors for CKD.

Table 5.1 Participant demographics and clinical characteristics

Characteristics		N	%
Total		**143**	**100**
Mean age (years; mean ± S.D., range)		**63.6 ± 6.5 (50-74)**	
Gender			
Female		78	54.5
Male		65	45.5
Region			
South		68	47.6
North/north east		37	25.9
North west/west		38	26.6
Smoking status			
Non-smoker		83	58.0
Ex-smoker		41	28.7
Light smoker (less than 10 cigarettes/day)		12	8.4
Moderate smoker (10 to 19 cigarettes/day)		5	3.5
Heavy smoker (20 or over cigarettes/day)		2	1.4
Diabetes			
Type 1		0	0
Type 2		30	21.0
Heart failure		**1**	0.7
High blood pressure		**121**	84.6
History of a heart attack, angina, stroke or transient ischaemic stroke		**18**	12.6
Immediate family* history of kidney disease		**14**	9.8
Body mass index (kg/m^2)			
Underweight	<18.5	0	0
Healthy	18.5-24.9	21	14.7
Overweight	25-29.9	55	38.5
Obese	≥30	67	46.9

Characteristics		N	%
Total		**143**	**100**
Qkidney risk range (%)			
Risk category	Percentage risk		
Low	<3	74	51.7
Moderate 1	3-7.9	41	28.7
Moderate 2	8-15	19	13.3
Severe	>15	9	6.3

*mother, father, brother or sister

Cronbach's alpha for the nine-item survey was 0.87, suggesting good internal consistency. Table 5.2 shows the percentage of participants rating the individual items on the satisfaction survey as 'agree' and 'strongly agree'. The majority of participants agreed that the time required to undergo the risk assessment process was justified (90.2%), overall they were satisfied with the CKD risk assessment service (90.0%), and they felt comfortable with the pharmacist referring their results to their doctor (88.7%). Comparatively, a lower percentage (65.8%) of participants agreed that risk assessment raised their awareness of CKD.

Table 5.2 Percentage of participants rating the individual items on the satisfaction survey as 'agree' and 'strongly agree' (n = 143)

Item no.	Survey item	Total no.*	Agree (%)	Strongly agree (%)	Total (%)
1	Risk assessment raised my awareness on chronic kidney disease.	143	41.3	24.5	65.8
2	Chronic kidney disease risk assessment service is useful.	141	41.1	44.7	85.8
3	Community pharmacy is a convenient place to perform chronic kidney disease risk assessment service.	143	40.6	40.6	81.2
4	The time required to undergo the risk assessment process was justified.	142	47.9	42.3	90.2
5	Privacy provided during the risk assessment process was acceptable.	141	40.4	37.6	78.0
6	I feel comfortable with the pharmacist referring my risk assessment results to my doctor.	142	36.6	52.1	88.7
7	The risk assessment results were clearly explained and understandable.	141	46.1	39.7	85.8
8	Brochures and leaflets provided on chronic kidney disease were informative.	137	52.6	26.3	78.9
9	Overall, I was satisfied with the chronic kidney disease risk assessment service.	141	56.0	34.0	90.0

*The total number of participants does not add up to 143 for several items due to missing data.

Table 5.3 shows results of the participants' willingness to pay for the CKD service. Of 136 participants who answered the question on willingness to pay, 62.9% (n = 90) were willing to pay for this service. Of these, 26, 23 and 17 participants were willing to pay $20, $10 and $5, respectively.

Table 5.3 Results of participants' willingness to pay for the chronic kidney disease risk assessment service

	N	%
Total	**143**	**100**
Willingness to pay for the service (n = 136)		
Yes	90	62.9
No	46	32.2
Amount willing to pay for the service (n = 89)		
$ 5	17	19.1
$ 10	23	25.8
$ 15	13	14.6
$ 20	26	29.2
$ 25	10	11.2

Of 40 participants who provided comments on the CKD risk assessment service, 13 provided appreciative comments about the service.

"Well done for bringing this kidney screening service to the community."

"…I was very happy with the treatment I received and that it (the CKD service) was very informative."

Some participants (n = 8) felt that in order to be able to take advantage of the service, it should either be free or the government should compensate for it.

"I feel the government should help out for elderly or anyone over 55 years of age."

"(I) am a pensioner, so I think it should be free."

There were no statistically significant associations between participant characteristics and either individual items of the satisfaction survey or willingness to pay for the CKD service.

5.5 Discussion

Overall, the results showed that participants were highly satisfied with the CKD service. The majority of participants were comfortable with pharmacists referring their risk results to their doctor, and found that the time required to undergo risk assessment was justified. However, a lower percentage of participants agreed that risk assessment increased their awareness of CKD. During risk assessment, pharmacists provided participants with a brief explanation of their risk assessment results, and written education material on CKD. However, the CKD service did not involve a verbal educational component.

There was no statistically significant association between participant characteristics and level of satisfaction with various aspects of the CKD service. These findings suggest that patients generally appreciated the service, regardless of their age, gender, clinical characteristics and risk of developing moderate-severe CKD.

Our study showed no significant association between various participant characteristics and their willingness to pay for the CKD service. Conversely, previous studies[153-155] have shown factors (other than those assessed in this study) such as higher annual income, patient perception of their health status (higher willingness to pay in those with perceived health status of average than good or very good), increasing pharmacists' counselling time, and patients' perception of pharmacists' abilities, to significantly and positively enhance patients'

willingness to pay for various pharmacy services. Additional investigations are therefore needed to determine various influential factors that might further explain patients' willingness to pay for pharmacy screening services.

Some participants mentioned that the CKD service should be either free or subsidised by the government. This might be because several people in this age category (50-74 years) would be living on retirement pension. Currently, in Australia, only diabetes screening is being subsidised by the government, and other health services are generally provided free of cost.[93] However, one has to acknowledge that workflow challenges and shortage of time are typically the major barriers to pharmacists' effective implementation of health promotion and disease prevention interventions.[127, 139] Therefore, if there is no financial return, pharmacists are most likely to discontinue these services, even if these provide significant patient benefit.

Due to the long follow-up time interval, this study had to be performed nine months after the participant underwent CKD risk assessment. This could have adversely influenced the response rate. The reliability of our nine-item satisfaction survey was good. Further research is needed to test and validate this survey in a larger population.

5.6 Conclusion

Overall, patient satisfaction with the community pharmacy-based CKD risk assessment service was high. Also, most patients were willing to pay for risk assessment. Thus, from the patient perspective, the CKD service is worth incorporating within community pharmacy practice. However, to further improve the quality of this service, it should provide additional education on CKD.

PROJECT III

CHAPTER 6. Knowledge about Chronic Kidney Disease in the Australian Public Evaluated Using A New Validated Questionnaire: A Cross-Sectional Study

6.1 Abstract

6.1.1 Background

Public awareness of chronic kidney disease (CKD) is an important determinant of the uptake of screening programs, which may help to address the CKD burden. The aim of this study was to determine the CKD knowledge of the Australian public.

6.1.2 Methods

A CKD knowledge questionnaire was developed after reviewing the literature and discussions with nephrology experts. Content and face validity was performed by nephrologists (n = 3), renal nurses (n = 3) and research personnel (n = 4). The questionnaire was piloted in 121 public participants. Next, discriminant validation was performed by recruiting two additional groups of participants, to add to the public sample: final year undergraduate pharmacy students (n = 28) and nephrologists (n = 27). Reliability of the questionnaire was assessed by calculating Cronbach's alpha. In phase 2, a cross-sectional survey of the Australian public (n = 943) was conducted using the validated questionnaire. It was administered using an online Omnibus survey. Quota sampling was used for participant selection and to ensure that the final sample

would match the key characteristics of the Australian population. Finally, a standard multiple regression analysis was performed to identify predictors of the public knowledge.

6.1.3 Results

Phase 1: The median CKD knowledge scores of the public, students and nephrologists were 12, 19 and 23, respectively, with statistically significant differences in the scores across the three groups ($p < 0.001$; Kruskal-Wallis test). The Cronbach's alpha for the questionnaire was 0.88, indicating that the questionnaire had good internal consistency. Phase 2: The online survey was closed after one week, during which time 2,173 people accessed the survey and 1,034 provided complete responses (response rate of 4.2%). A sample of 943 eligible participants were included in the final analysis and their mean (SD) age was 47.6 (±16.6) years and 51.2% were female. The mean (SD) knowledge score was 10.3 (± 5.0). The multivariate analysis showed that participants with a higher level of education; with a family history of kidney failure; with a personal history of diabetes; and currently or previously living in a relationship had significantly higher knowledge scores.

6.1.4 Conclusion

In Australia, the public knowledge about CKD was poor and there is a need to improve their knowledge, perhaps through nationwide awareness programs.

6.2 Introduction

The global burden of CKD has increased significantly, causing > 500,000 deaths since 1990.[2, 156] Between 2005 and 2013, the global age-standardised mortality rate for CKD has increased by approximately 37%.[2] Despite this, CKD has received relatively limited global attention and needs effective public health interventions for prevention and management.[2] Early detection and treatment of CKD in its initial stages may help in the prevention or delaying of disease progression.[6] Many clinical practice guidelines for CKD, such as Kidney Health Australia (KHA) - Caring for Australasians with Renal Impairment (CARI), recommend screening of people with risk factors for CKD[6, 63, 157] and several screening programs have been conducted worldwide to identify people with early stages of CKD within the community.[106]

More generally, health promotion and early detection are important strategies adapted by the Australian government within the national health policy to address increasing rates of chronic diseases.[158] However, there appears to be a lack of understanding amongst the Australian community about the preventability of major health conditions.[159, 160] An Australian survey, which included items to determine the public's ability to adopt disease preventive measures and engage in early detection by understanding health alerts in the media and public displays for inoculations and screening, found less than adequate levels of health literacy in approximately 60% of participants.[161] Limited public knowledge of the particular disease itself is another important barrier to the successful implementation of prevention programs.[124, 159, 162] For instance, a cross-sectional survey of Australian adults showed that even amongst subgroups of cohorts with the greatest risk of CKD, the knowledge of CKD risk factors and the recall of kidney function testing were both limited.[124]

Public awareness of CKD is an important determinant of the uptake of screening programs,[163, 164] which may help to address the CKD burden. Determining the public

knowledge of CKD can also provide guidance to medical health professionals, researchers and kidney health organisations when establishing the need for education campaigns. The few studies conducted to assess the public knowledge of CKD, used questionnaires that were not validated,[124, 165-167] with no such study performed in the general Australian population. Therefore, the primary aim of this study was to determine the knowledge about CKD in the Australian public using a newly developed and validated questionnaire. The secondary aim was to determine potential predictors of CKD knowledge in the Australian public.

6.3 Methods

The Tasmanian Health and Medical Human Research Ethics Committee (H0015680) approved this study, which involved two phases: Phase 1) Development and validation (content and discriminant validity) of the CKD knowledge questionnaire, and Phase 2) A cross-sectional survey to evaluate the Australian public knowledge of CKD. Written consent was obtained for all participants except those who completed the questionnaire online. Completion of the online questionnaire by an eligible participant itself implied the consent to participate in this study.

Phase 1) Development and validation

The initial draft of the CKD knowledge questionnaire was generated through literature review of existing public[165-167] and related questionnaires,[124, 168-172] following discussions with nephrology and research experts. The questionnaire was divided into 5 sections and included a total of 35 evidence-based questions on the physiology of the kidneys, 'Kidney Health Check',[5] risk factors for CKD[173] and signs and symptoms of advanced CKD or kidney failure. Seven control items were added to the questionnaire for methodological validity. The questionnaire and the correct answers to knowledge questions were reviewed for content and face validity by nephrologists (n = 3), renal nurses (n = 3) and research personnel (n = 4). For each section,

reviewers were asked to evaluate individual items and highlight those that were deemed inappropriate in terms of phrasing and applicability. Consequently, items that would require a clinical level of expertise were deleted, and several items were rephrased so that a layperson could better understand them. The final draft of the questionnaire is provided as an additional file (Appendix 5.1) consisted a total of 24 questions with the multiple-choice options 'True', 'False' and 'I don't know'. Correct responses were given a score of 1 and incorrect responses were given a score of 0. The option 'I don't know' was considered as lack of knowledge and given a score of 0.

Next, the questionnaire was piloted and involved recruitment of eligible people visiting the central shopping district and a suburban shopping centre in Hobart, Tasmania. Eligible people were adults (≥18 years) who were not registered healthcare professionals, such as a doctor, nurse, pharmacist or dietitian, and did not have a personal history of kidney failure. A researcher visually determined the eligibility of a potential participant and approached them for participation. Those willing to participate (after confirmation of eligibility) were required to complete the questionnaire on the spot. The first five participants additionally assessed the questionnaire for clarity, formatting and phrasing. Sample size for this pilot phase was calculated as per the recommendations made by Viechtbaur et al.[174] To be 99% certain that the pilot study would detect any unforeseen problems e.g. misinterpretations of the questionnaire items with a problem probability of 0.05, at least 90 participants was needed.

To determine the discriminant validity of the questionnaire, two additional groups of participants were recruited: final (fourth) year undergraduate pharmacy students and nephrologists. Pharmacy students from the University of Tasmania were invited to answer the self-administered questionnaire during their regular university tutorial sessions. Nephrologists completed an online questionnaire following recruitment through an advertisement in the

Australian and New Zealand Society of Nephrology's weekly newsletter. No previous data (from a pilot study) was available to perform a statistical power analysis for sample size estimation. Therefore, choosing a large effect size of 0.40, with an alpha = 0.05 and power = 0.80, the projected sample size needed was approximately N = 66 (22 per group) for between-group comparisons.[175] It was hypothesised that the mean knowledge score would be highest for nephrologists, followed by students and lastly the public.

Reliability of the questionnaire was measured by calculating the Cronbach's alpha. Next, normality of distributions of the continuous variable was determined using the Shapiro-Wilk test. The Kruskal-Wallis test was used to determine if there were any statistically significant differences between the knowledge scores of the three groups (i.e. public, students and nephrologists). Post-hoc tests were performed using Mann-Whitney U tests to determine which groups were significantly different ($p < 0.005$) from one another.

Phase 2) Cross-sectional survey

The above-validated questionnaire was used to evaluate the public knowledge of CKD. Based on the Phase 1 data, it was estimated that at least 50% of the sample would have a total score of at least 50% of the maximum achievable score on the questionnaire. Using a 5% precision and 99% confidence level, to be 99% sure that the true percentage of the public that would achieve at least 50% score on the questionnaire was between 45% and 55%, 665 eligible participants were needed. The questionnaire was administered using I-view's (an Australian market and social research data collection agency; http://www.iview.com.au/) online Omnibus service. [176] The Omnibus is conducted over a period of one week once fortnightly, and provides a national sample of 1000 adults (≥18 years). I-view's online panel 'MyView' was used as the sampling frame; it consists of approximately 130,000 Australian adults (≥18 years) and overseas visitors staying or intending to stay in Australia for 12 months or more. Quotas were

set according to age, gender and geographical locations (divided according to state, and by metropolitan and rural areas) to ensure that the final sample would match the characteristics of the Australian population, as per the Australian Bureau of Statistics (ABS) 2011-census data.

The online Omnibus was conducted between 2nd and 6th November 2016. Respondents who completed the survey in under half of the median survey length were identified as skimmers and excluded. Post-stratification was used to make adjustment to the weights so that the resultant weighted estimates from the sample conform to the Australian population values for age, gender and location. The sample (cross-sectional survey data) joint distribution and population (ABS census 2011 data) joint distribution of all three variables (age range, gender and location) was determined. Post-stratification was performed using the rim weighting method.[177] Rim weighting allows benchmarking sample distributions to that of the population distributions. It is an iterative proportional fitting procedure, where all three variables were simultaneously weighted until a convergence was reached.

After the weighted data were obtained from I-view, participants were excluded if they identified themselves as a healthcare professional (such as a doctor, nurse, pharmacist or dietitian) or had a personal history of kidney disease. Given the large sample size, the central limit theorem holds true, and it was reasonably assumed that the distribution of the total score would be approximately normally distributed.[178] Next, bivariate analyses was performed using one-way ANOVA and independent t-tests, as appropriate, to compare the effect of participants' sociodemographic characteristics on the CKD knowledge score. A multivariable linear regression model was then constructed to predict the knowledge score based on potential predictor variables ($p < 0.10$, using bivariate analysis), and a standard multiple regression analysis was performed. We confirmed the assumptions of normality, linearity and multicollinearity.

The software Statistical Package for the Social Sciences (SPSS) version 23.0 and G*Power version 3.1 were used to perform the statistical analyses.

6.4 Results

Phase 1) Development and validation

Complete responses were received from 28 students, 27 nephrologists and 121 participants from the public, and these were included in the analysis. These corresponded to over 85% of the students (n = 31) who attended the university tutorial session and members of the public approached, while the nephrologists voluntarily accessed the online questionnaire. Appendix 5.2 shows the percentage of correct responses to individual items on the questionnaire by all three groups. The Cronbach's alpha was 0.88 (95% CI: 0.86-0.91), indicating that the questionnaire had good internal consistency.

The p-value for the Shapiro-Wilk test was <0.05, indicating that the data were not normally distributed. Therefore, non-parametric statistical tests were used to perform subsequent analyses. The Kruskal-Wallis test revealed a statistically significant difference in the total score of participants across the three groups (χ^2 (2, N = 176) = 109.7, $p < 0.001$). The median total scores of the nephrologists, students and public were 23, 19 and 12, respectively. Post-hoc comparisons performed between pairs of groups found statistically significant differences between all three groups ($p < 0.001$).

Phase 2) Cross-sectional survey

A total of N = 24,662 people were invited to participate in the online Omnibus survey. The survey was closed after one week, during which time 2,173 people accessed the survey and 1,034 provided complete responses (response rate of 4.2%). A total of 73 participants were identified as a registered healthcare professional or had a personal history of kidney disease,

and 18 had unclear sociodemographic characteristics; these were excluded. Thus, a sample of 943 participants was included in the final analysis, and Table 6.1 shows participant characteristics and their comparison with the Australian public. Since this sample was matched to only Australian public values for age, gender and location, there are differences in the proportions under the categories education and country of birth. More specifically, this sample had a higher proportion of Australian-born participants and individuals who were higher degree/postgraduate diploma/bachelor degree holders and diploma/vocational holders.

Table 6.1 Participant socio-demographic characteristics

Characteristics	Participants		Australian public	
	N	%	N	%
Total	**943**	**100**	**16,517,613**	**100**
Age (Mean ± S.D., range)	47.6 ± 16.6, 18-84			
Age range (years)				
18 – 29	181	19.2	3,533,626	21.4
30 – 49	347	36.8	6,020,939	36.4
50 +	415	44.0	6,963,048	42.2
Gender				
Female	483	51.2	8,446,803	51.1
Male	460	48.8	8,070,810	48.8
Country of birth				
Australia	727	77.1	10,674,865	64.6
Not Australia	216	22.9	5,842,748	35.4
Education				
Higher degree or postgraduate diploma/Bachelor degree	299	31.7	3,268,574	19.8
Diploma/Vocational	345	36.6	1,392,191	8.4
Completed highest level of school	178	18.9	2,639,997	16.0
Did not complete highest level of school	121	12.8	472,469	2.9
Occupation				
Professional/Managerial	189	20.0		
Sales/Clerical	147	15.6		
Technical/Skilled	81	8.6		
Unskilled/Labourer	53	5.6		
Other occupations	53	5.6		
Do not work	420	44.5		

Characteristics	Participants		Australian public	
	N	%	N	%
Total	**943**	**100**	**16,517,613**	**100**
Work outside home				
Yes, full-time	331	35.1		
Yes, part-time	192	20.4		
No (Not employed, student, work at home, homemaker, retired, etc.)	420	44.5		
Gross annual income				
Under $50,000	348	36.9		
$50,000 to just under $100,000	281	29.8		
$100,000 and over	208	22.1		
Refused	103	11.2		
Marital status				
Married/Common law, De-facto or Living with a partner	568	60.2		
Single/Never married	227	24.1		
Divorced/Separated/Widowed	148	15.7		
Number of people in the household				
One	186	19.7		
Two	349	37.0		
Three	163	17.3		
Four	172	18.2		
Five or more	73	7.7		
Children under 18 years of age				
Yes	285	30.2		
No	658	69.8		
Area description				
Within a capital city	535	56.7		
Within a major regional city	234	24.8		

Characteristics	Participants		Australian public	
	N	%	N	%
Total	**943**	**100**	**16,517,613**	**100**
Within a rural town or its surrounds	144	15.3		
More than 5km from the nearest town	30	3.2		
State				
New South Wales	296	31.4	5,316,815	32.2
Victoria	257	27.3	4,149,390	25.1
Queensland	181	19.2	3,278,855	19.8
Western Australia	85	9.0	1,709,692	10.4
South Australia	84	8.9	1,247,852	7.6
Tasmania	24	2.5	381,299	2.3
Australian Capital Territory	13	1.4	277,559	1.7
Northern Territory	3	0.3	153,716	0.9
Other territories	0	0	2433	0.0
Aboriginal or Torres Strait Islander descent				
Yes	15	1.6	10,329	0.1
No	928	98.4	16,507,284	99.9
Family member working as a registered healthcare professional e.g. doctor, nurse, dietician or pharmacist				
Yes	55	5.8		
No	888	94.2		
Family history of kidney failure				
Yes	47	5.0		
No	896	95.0		
Medical condition(s)/illness(es) that require regular medications				
High blood pressure known as hypertension				
Yes	220	23.3		
No	704	74.7		

Characteristics	Participants		Australian public	
	N	%	N	%
Total	**943**	**100**	**16,517,613**	**100**
I don't know	19	2.0		
Raised blood sugar known as diabetes				
Yes	81	8.6		
No	840	89.1		
I don't know	22	2.3		
Heart problems such as heart failure or heart attack				
Yes	42	4.5		
No	877	93.0		
I don't know	24	2.5		
Personal history of stroke				
Yes	18	1.9		
No	900	95.4		
I don't know	25	2.7		

Blanks indicate that the data for the Australian public was not available.

*Sample was post-weighted to match only three Australian public characteristics (age, gender and state).

`Variables do not add up to total due to education information inadequately described or not stated by the Australian public.

The mean (SD) knowledge score of the Australian public was 10.34 (± 5.0), with values ranging from 0 to 22. The percentage of the public who scored at least 50% on the questionnaire was 63.3. As shown in Figure 6.1, 50% of the participants had knowledge scores less than 11. Table 6.2 shows the percentage of participants with correct responses to individual items on the questionnaire. Most participants knew that kidneys make urine (62.1%) and clean blood (69.8%); however, very few identified that kidneys help to maintain blood pressure (BP) (26.4%) and keep the bones healthy (14.3%). Many participants identified diabetes (60.6%) as

a risk factor, but hypertension (38.3%) was less frequently recognised. Most participants knew that urine (76.2%) and blood (68.2%) tests help to determine the kidney health; however, only 20.3% people knew that BP monitoring also helps in evaluating kidney health. Only 23.4% knew that herbal supplements are not effective in treating CKD and just over 50% knew that medication could help in delaying the progression of CKD.

Figure 6.1 Distribution of the chronic kidney disease knowledge scores of the Australian public (n = 943)

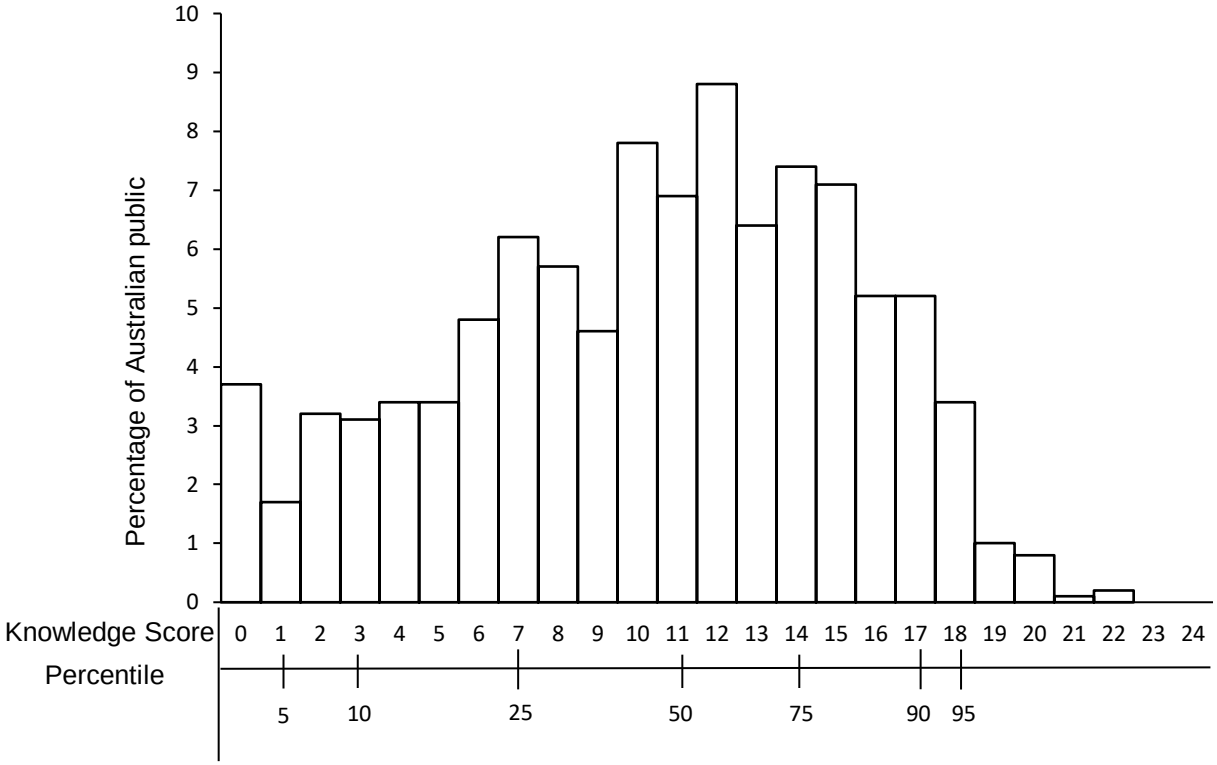


Table 6.2 Percentage of correct response to individual items on the questionnaire by the Australian general population (N = 943)

Item No	Question	Correct response (%)
1*	A person can lead a normal life with one healthy kidney.	85.6
2	Herbal supplements can be effective in treating chronic kidney disease.	23.4
3*	Certain medications can help to slow-down the worsening of chronic kidney disease.	51.2
What functions do the kidneys perform in the body?		
4*	The kidneys make urine.	62.1
5*	The kidneys clean blood.	69.8
6	The kidneys help to keep blood sugar level normal.	22.6
7*	The kidneys help to maintain blood pressure.	26.4
8	The kidneys help to breakdown protein in the body.	14.3
9*	The kidneys help to keep the bones healthy.	14.3
Which of the following are commonly used to determine health of the kidneys?		
10*	A blood test.	68.2
11*	A urine test.	76.2
12	A faecal (poo) test.	45.9
13*	Blood pressure monitoring.	20.3
What are the risk factors for chronic kidney disease?		
14*	Diabetes.	60.6
15	Being female.	42.4
16*	High blood pressure.	38.3
17*	Heart problems such as heart failure or heart attack.	26.3
18	Excess stress.	16.4
19*	Obesity.	58.6

Item No	Question	Correct response (%)
What are the signs and symptoms that a person might have if they have advanced chronic kidney disease or kidney failure?		
20*	Water retention. (excess water in the body)	61.1
21	Fever.	15.2
22*	Nausea/vomiting.	37.6
23*	Loss of appetite.	38.4
24*	Increased fatigue (tiredness).	58.7

***** True items

The analysis of variance (Appendix 5.3) showed significant associations between the CKD knowledge score and socio-demographic variables, such as age, education, occupation, annual income and marital status, and a personal history of hypertension, diabetes, heart disease and stroke ($p < 0.01$). There was also a significant difference ($p < 0.01$) in the knowledge scores of participants with and without a family history of kidney failure (Appendix 5.4). A multiple linear regression was performed to predict the CKD knowledge score based on age, education, occupation, marital status, family history of kidney failure, and a personal history of hypertension, diabetes, heart disease and stroke. The bivariate analysis showed that participants who refused to reveal their annual income had statistically significantly lower knowledge scores than the other category participants. This participant characteristic was excluded.

Table 6.3 shows the results of the standard multiple regression analysis between CKD knowledge score and participant characteristics. A significant regression equation was found ($F(21,921) = 4.58$, $p < 0.001$), with an R^2 of 0.095. The multivariate analysis found higher knowledge scores associated with a higher level of education, such as possessing a postgraduate diploma or bachelor degree and diploma/vocational certificate. A family history of kidney failure was also independently associated with higher knowledge scores, as was a

personal history of diabetes. Finally, participants currently or previously within a relationship (married, de-facto or living with a partner and divorced/separated/widowed) had significantly higher knowledge scores than those who were single/never married.

Table 6.3 Standard multiple regression analysis between CKD knowledge score and participant characteristics

Characteristics	β coefficient (95% CI)	*p* value
Age range (years)		
18 – 29*		
30 – 49	-0.06 (-1.56 to 0.25)	0.16
50 +	0.04 (-0.57 to 1.43)	0.40
Education		
Did not complete highest level of school*		
Completed highest level of school	0.01 (-0.99 to 1.28)	0.80
Diploma/Vocational	0.11 (0.10 to 2.14)	**0.03**
Higher degree or post graduate diploma/Bachelor degree	0.16 (0.58 to 2.79)	**0.003**
Occupation		
Do not work*		
Unskilled/Labourer	-0.04 (-2.35 to 0.43)	0.18
Technical/Skilled	-0.01 (-1.27 to 1.10)	0.89
Sales/Clerical	-0.02 (-1.23 to 0.67)	0.57
Professional/Managerial	0.06 (-0.32 to 1.64)	0.11
Other occupations	0.05 (-0.39 to 2.43)	0.16
Marital status		
Single/Never married*		
Married/Common law, De-facto or Living with a partner	0.10 (0.21 to 1.80)	**0.01**
Divorced/Separated/Widowed	0.10 (0.28 to 2.48)	**0.01**
Family history of kidney failure		
Yes vs No	0.08 (0.39 to 3.24)	**0.01**

Characteristics	β coefficient (95% CI)	*p* value
Medical condition(s)/illness(es) that require regular medications		
High blood pressure known as hypertension		
Yes*		
No	-0.02 (-1.09 to 0.55)	0.52
I don't know	-0.09 (-6.84 to 0.29)	0.07
Raised blood sugar known as diabetes		
Yes*		
No	-0.09 (-2.54 to -0.22)	**0.02**
I don't know	-0.07 (-5.37 to 0.79)	0.15
Heart problems such as heart failure or heart attack		
Yes*		
No	0.01 (-1.29 to 1.86)	0.73
I don't know	0.03 (-2.31 to 4.22)	0.57
Personal history of stroke		
Yes*		
No	-0.09 (-4.32 to 0.27)	0.08
I don't know	-0.16 (-8.43 to -1.15)	**0.01**

*Reference; R^2 for the model = 0.095.

6.5 Discussion

Overall, the results of this study show poor understanding of CKD amongst the Australian public. Participants in this study had limited knowledge of the physiological role of the kidneys, especially relating to the regulation of BP, and bone development and metabolism. Participant knowledge about CKD risk factors was also limited. Less than half of the participants correctly identified hypertension as a risk factor. This percentage was higher, however, than the 2.8% reported in a study of 852 Australians by White et al.[124] In a public survey of 748 participants conducted in Iran,[166] only 14.4% selected 'unmanaged hypertension' as 'very likely to result

in CKD'; whereas a study of 516 community-dwelling Hong Kong adults reported that 43.8% participants knew that hypertension can cause kidney disease.[165] Additionally, a cross-sectional study of 454 participants conducted in South-West Nigeria found that 54.7% believed that hypertension was a CKD risk factor.[167] Conversely, the percentage of participants (60.6%) who correctly identified diabetes as a risk factor in this study was high as compared to the 8.6%, 12.7%, 44.0% and 49.0% reported by White et al.,[124] Roomizadeh et al.,[166] Chow et al.[165] and Oluyombo et al.,[167] respectively.

Only half of the participants knew that medications can help to slow the worsening of CKD. This suggests that the Australian public's understanding of the treatment of kidney failure is relatively poor. In addition, only 23.4% of participants knew that herbal supplements are ineffective in treating CKD. Some herbal supplements have been associated with the development of CKD[179] and related to acute kidney injury.[180] Also, concomitant use of herbs and conventional drugs can cause drug toxicity and therapeutic failure via alteration in renal function.[181] With the increasing availability and use of herbal medicines in high-income countries,[10] efforts should be made to educate people on their potentially harmful repercussions, and their use should be strongly discouraged in people with kidney disease.

KHA recommends that people with diabetes or hypertension should undergo a 'Kidney Health Check' every year.[5] A 'Kidney Health Check' includes three assessments: a blood test to determine the estimated glomerular filtration rate (indicates level of kidney function); a urine test to check for albuminuria (marker of kidney damage); and an assessment of BP because kidney disease can be an outcome of high BP or cause renal hypertension. More than 65% of participants in this study knew that blood and urine tests can be used to determine kidney health; however, few correctly identified a BP assessment. Both hypertension and CKD are silent diseases, which warrant regular monitoring for prevention and management. There is a

need to create improved awareness about BP, its regular monitoring and its association with CKD amongst the Australian public.

The multivariate analysis showed that CKD knowledge score increased with a higher level of education; this is consistent with the findings of other studies.[165, 167] Additionally, our regression model showed that participants who were single or never married had lower CKD knowledge scores. This may be because people who have lived or are living with others are more actively involved in acquiring health-related information and implementing healthy lifestyles.[182-185] Another important predictor variable was a family history of kidney failure. This was an expected outcome because knowing a person with kidney failure would be anticipated to indirectly raise awareness on the same.

White et al.[124] and Chow et al.[165] found, similar to this study, that participants with a personal history of diabetes had better knowledge. Although this predictor variable reached statistical significance in the final model, the mean total score of patients with diabetes was low (11.8 out of a possible score of 24). This suggests that even though patients with diabetes had better knowledge when compared with the public, their overall CKD knowledge was still poor. Similarly, even though participants with other existing co-morbidities had comparatively higher mean scores, the values were still around half of the maximum achievable on the questionnaire. This demonstrates that even amongst the cohorts at highest risk of developing CKD, awareness is relatively low. The KHA-CARI guidelines recommend that physicians should provide early CKD education to patients with CKD risk factors as this may prevent CKD development and progression.[6] A recent Australian study conducted to determine the kidney disease health-literacy among new patients referred to specialist nephrology care reported that 35.8% patients had received no education and 46.2% had little, but inadequate, information on their kidney problem when being referred by their doctor.[170] When asked what

causes CKD, almost 40% patients answered ‘unsure’ and approximately 30% answered ‘alcohol’. The reliability of our newly developed and validated questionnaire was good. Hence, primary care physicians can use this questionnaire to evaluate CKD knowledge and subsequently provide tailored education to patients at risk of developing CKD.

Some inconsistencies were found when comparing the questionnaire results of this study with those of others. These, in part, may be because of the exploratory nature of the questions and non-validated questionnaires used in other studies. Creating a questionnaire that can produce valid and reliable data is a complex process, and guidelines are available for developing and validating questionnaires before their use in cross-sectional studies.[186-188] Despite this, studies have often used non-validated questionnaires.[186]

Prior to the future use of this questionnaire, several improvements that could be made include: 1) Rephrasing section 2 as “What major functions do the kidney perform in our body?” (noting that there is some involvement in controlling blood glucose levels) and 2) Addition of an item under Section 2 “Kidneys help in the production of red blood cells” (True Item).

It is acknowledged that the sample may not have been truly representative of the general public. It was weighted to match the Australian population for only age, gender and location, and had a relatively high proportion of participants who were higher degree/postgraduate diploma/bachelor and diploma/vocational degree holders. Also, more than 20% of the participants had a gross annual income of $100,000 and over. Despite this, the mean total score of participants was less than 50% of the maximum score achievable on the questionnaire. This suggests that everyone should be targeted for CKD education, irrespective of their sociodemographic backgrounds. While the regression model was statistically significant, the R square value was low. Hence, future studies should explore additional predictors, which can further assist in understanding the low CKD knowledge of the public.

6.6 Conclusions

A valid and reliable questionnaire to measure the CKD knowledge of the general population was developed and tested in this study. Australian public knowledge of the physiological role of the kidneys, and CKD and its risk factors was poor, irrespective of sociodemographic and clinical characteristics. Healthcare professionals within primary care settings should evaluate the CKD knowledge of patients with CKD risk factors and, if warranted, provide tailored education. As for the public, there is a need to increase their understanding of kidneys and knowledge of CKD through nationwide awareness programs. These efforts may improve the early detection and management of CKD.

General Discussion

Overall, the research described in this thesis highlights some effective strategies, the implementation of which could help to improve the early detection and prevention of CKD in Australia. A review of the targeted screening interventions for CKD showed that almost all interventions inadequately followed the clinical guidelines for initial detection of CKD. The analysis further indicated that interventions lacking methodological rigour may result in an increased risk of over-diagnosis, inefficient use of resources, and unnecessarily labelling many people as diseased within the community. This raises significant concern because the true effectiveness of targeted screening cannot be established. We suggest that researchers, healthcare professionals, and kidney health organisations, should appropriately use these evidence-based clinical guidelines in future interventions, if they are to benefit the public. More specifically, the interventions should use simultaneous testing approaches (i.e. eGFR and ACR), and perform repeated testing in people identified with positive screening test results. The systematic review also highlighted that almost all screening interventions for CKD performed in the community settings lacked sufficient evidence to support their long-term feasibility. Instead, a better approach would be to incorporate the strategy of targeted screening within the healthcare model. Hence, Project II was implemented which evaluated the effectiveness of a CKD risk assessment service in community pharmacy settings.

Limitations

Project II showed a considerable scope for improving the public awareness and early detection of CKD via implementation of a pharmacy-based CKD risk assessment service. However, specific barriers hindered the service from reaching its full potential. An important one was that, in comparison with Canadian community pharmacists,[51] Australian pharmacists still do not have the authority to order laboratory tests. Hence, participant follow-up for the CKD risk assessment was completely dependent on GPs. Additionally, pharmacists faced several challenges during service implementation. Therefore, prior to future implementation, several steps need to be taken to enhance the CKD service.

Two major barriers identified to the effective implementation of the CKD service were:

1. Inadequate inter-professional collaboration between community pharmacists and GPs, and
2. Suboptimal kidney testing in participants identified at moderate-severe risk of developing CKD over the next five years via the online QKidney® risk calculator.

The findings of Project II (B) and II (C) suggest that unless there is a close working relationship between community pharmacists and GPs, any pharmacy-based screening or risk assessment services are likely to have a low success rate. A systematic review evaluating the effectiveness of screening for diabetes and CVD in community pharmacies similarly reported that although pharmacies are feasible sites for screening, development of inter-professional relations between pharmacists and GPs, together with more robust referral pathways, are necessary to ensure participant follow-up.[48] Thus, identification and implementation of strategies to enhance pharmacist-GP collaboration, prior to providing the CKD service, are necessary.

In Project II (C), several pharmacists mentioned that they briefly communicated the CKD risk assessment service to the GPs once at the beginning of the study. This manner of communication could have possibly resulted in limited GP involvement. Previous studies have indicated open, face-to-face and high frequency of communication, and combined meetings or continuing educational activities as important strategies for improving inter-professional collaboration.[119, 189-197] One qualitative study showed that GPs highly approve of the home medications review service performed by community pharmacists in Australia.[119] This is mainly because GPs perceived this service valuable for patient care, and important to ensure quality use of medicines. Similarly, a review of theoretical models, aimed to understand the pharmacist-GP collaboration and identify associated determinants, found that GPs are generally receptive towards those pharmacy services which provide patient benefit.[120] Hence during initial communication, preferably as a scheduled face-to-face meeting, it is necessary for pharmacists to provide GPs with detailed information on the CKD risk assessment service. More importantly, pharmacists should demonstrate to GPs the patient benefits from undergoing CKD risk assessment. These benefits include (i) early identification of initial stages of CKD and implementation of measures to prevent disease progression; and (ii) improved patient understanding about the functions of the kidneys, their individual risk of developing CKD based on their risk factor profile, the asymptomatic nature of CKD, the importance of regular 'Kidney Health Checks', and the significance of managing their existing risk factors, such as diabetes and hypertension.

GPs often lack confidence in the accuracy of the tests used for screening, and in pharmacists' clinical expertise and capabilities to perform extended professional services.[119, 120] A recent case study showed that GPs were more willing to advance their collaborative working relationship mainly because they were asked to provide input on the testing protocol and

training to ensure that they were confident with the pharmacists' role in providing point-of-care testing services.[198] Hence, pharmacists should demonstrate their professional expertise, and provide GPs with comprehensive evidence supporting the validity of the risk assessment tool. Also, GPs should be given an opportunity to discuss any queries and make suggestions associated with the CKD service and any requisite training. It is particularly important that pharmacists and GPs work together to explore and agree on a referral pathway (for e.g. e-mail, fax, mail, or telephone), which would be most effective to ensure patient follow-up as per their individual pharmacy and general practice environment.

Previous studies have shown that pharmacists and GPs have little appreciation and understanding of each other's contribution in patient care.[114, 121, 133, 140, 199] It was also determined that GPs might not be receptive towards a pharmacy service if they perceive it to compromise their patient relationship. Studies have shown trustworthiness and role specification as factors significantly responsible for increasing pharmacist-GP collaboration.[192, 196, 197, 200-202] Therefore, pharmacists should clearly define individual roles in providing the CKD service, and highlight sharing of responsibilities for overall patient benefit. Lastly, regular meetings between pharmacists and GPs should be organised to review the risk assessment and referral process, and implement changes as deemed necessary. This manner of communication (i.e. face-to-face, bidirectional decision-making and information sharing, and regular meetings) could theoretically lead to enhanced trust and interdependence between pharmacists and GPs, which is needed to form a robust collaborative practice.

It is possible that absence of a previously established collaborative practice could make pharmacists hesitant in approaching GPs, and fear that they might damage their existing relations.[119] Collaboration with GPs before implementation of a pharmacy screening service could prove to be more beneficial as shown by one study where patients were actually referred

to the pharmacists for screening and education by GPs.[203] Hence, training to improve pharmacists' confidence and communication skills, and providing them with information on the above mentioned strategies for enhancing inter-professional collaboration, would ensure that pharmacists are proactive in approaching GPs and engaging them in providing the CKD service.[120, 121, 133, 140, 204]

Another barrier identified within Project II (B) was the suboptimal kidney testing (i.e. measurement of both eGFR and urine ACR) in participants at moderate-severe risk of developing CKD. Similarly, the results of a pilot study implementing a CKD early detection and management program in Melbourne primary care settings showed that GPs still did not perform repeated testing to confirm CKD diagnosis in at-risk patients.[35] Currently, in Australia, screening for CKD is not routinely practised by any healthcare professional.[11] Literature shows that owing to the huge patient workload in primary care settings, GPs generally find it difficult to effectively perform preventative interventions.[37-39] A recent qualitative study conversely illustrated that Australian GPs were wary of the financial costs associated with the provision of additional non-claimable services, and believed that unfunded services, such as CKD screening, were difficult to justify in a private business environment.[40] An additional concern is the lack of GPs' adherence to KHA's recommended algorithm for initial CKD diagnosis,[6] especially for urine ACR testing in at-risk patients.[12, 34, 35]

In any case, the above mentioned barriers raise several important questions (listed below) which need to be explored and addressed by future studies in order to improve the efficacy of the CKD service.

1. What are the current clinical practices of GPs for CKD diagnosis and management? Under what circumstances do GPs generally perform kidney testing in their patients?

2. What are GPs' views regarding the 'early CKD detection and prevention' strategy?

3. What are the various factors (i.e. patient, disease or health insurance-related) that influence GPs' decision to order kidney tests for their patients?

4. What are GPs' perceptions of the pharmacy-based CKD risk assessment service? More specifically, what are GPs' opinions about the online QKidney® risk calculator and the recommendations for participant referral?

Directions for future research

Community pharmacists faced several challenges during the CKD service implementation. To address these, we recommend some refinements to various aspects of the CKD service. In Project II (A), the impact of a web-based training program on pharmacists' competence to deliver the CKD service was evaluated. This study demonstrated that, with appropriate training, pharmacists can efficiently perform the CKD service. However, prior to future implementation of the pharmacists' training program, we recommend the addition of four new topics under the lecture presentation, as shown in Figure C. These topics are:

1. Patient education on CKD,
2. Integration of the CKD service with other established services,
3. Training of pharmacy staff, and
4. Training to improve the inter-professional collaboration between pharmacists and GPs.

The revised CKD risk assessment protocol is shown in Figure D.

Figure C. The revised community pharmacists' training program for chronic kidney disease risk assessment service.

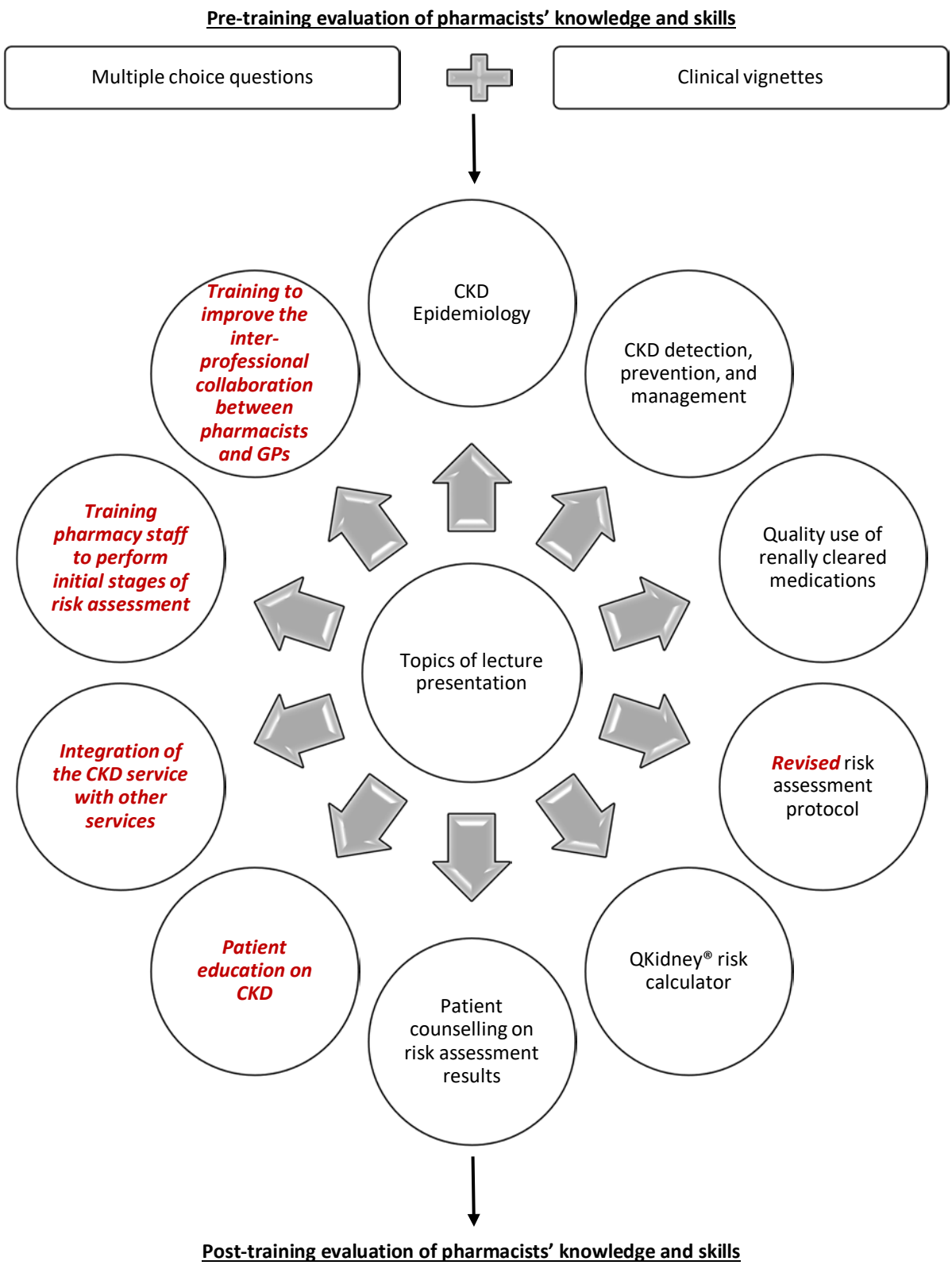
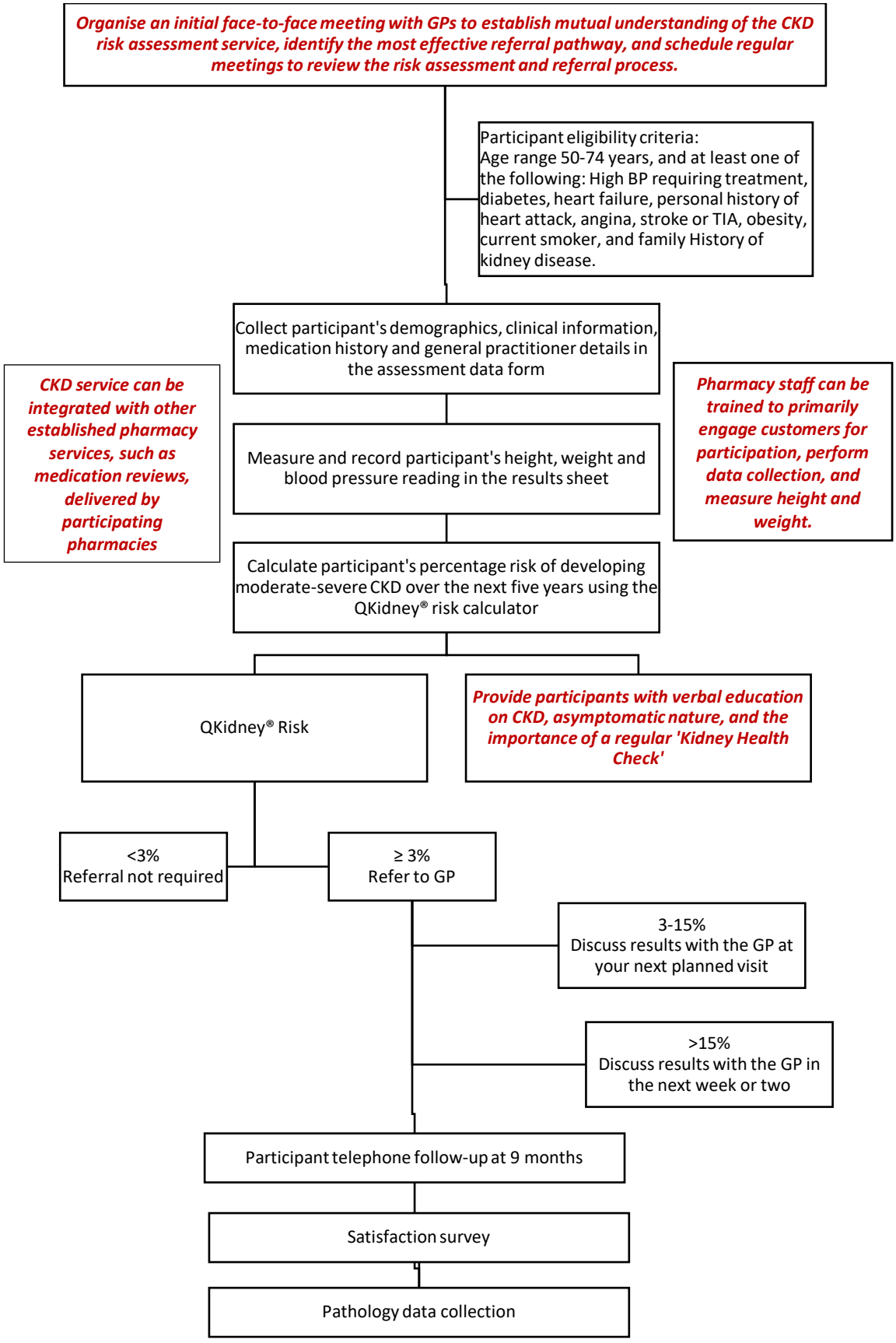


Figure D. Revised chronic kidney disease risk assessment protocol


Organise an initial face-to-face meeting with GPs to establish mutual understanding of the CKD risk assessment service, identify the most effective referral pathway, and schedule regular meetings to review the risk assessment and referral process.
Participant eligibility criteria:
Age range 50-74 years, and at least one of the following: High BP requiring treatment, diabetes, heart failure, personal history of heart attack, angina, stroke or TIA, obesity, current smoker, and family History of kidney disease.
Collect participant's demographics, clinical information, medication history and general practitioner details in the assessment data form
CKD service can be integrated with other established pharmacy services, such as medication reviews, delivered by participating pharmacies
Pharmacy staff can be trained to primarily engage customers for participation, perform data collection, and measure height and weight.
Measure and record participant's height, weight and blood pressure reading in the results sheet
Calculate participant's percentage risk of developing moderate-severe CKD over the next five years using the QKidney® risk calculator
QKidney® Risk
Provide participants with verbal education on CKD, asymptomatic nature, and the importance of a regular 'Kidney Health Check'
<3%
Referral not required
≥ 3%
Refer to GP
3-15%
Discuss results with the GP at your next planned visit
>15%
Discuss results with the GP in the next week or two
Participant telephone follow-up at 9 months
Satisfaction survey
Pathology data collection

The qualitative data analysis (Project II (C)) showed that pharmacists perceived their customers to have limited understanding of CKD and functions of the kidneys. During follow-up (Project II (B)), we found that relatively few patients had discussed their risk assessment results with their GP. Lastly, the analysis of the satisfaction survey data (Project II (D)) found a relatively low percentage of participants who agreed that risk assessment raised their awareness on CKD. A systematic review investigating the effectiveness of several strategies to improve diabetes care found interventions that targeted both patients and healthcare professionals to be most successful.[205] For example, this review found interventions designed to promote greater patient understanding of a target disease or to teach specific prevention or treatment strategies, in addition to the use of multidisciplinary team, to be more useful in reducing the overall patient risk factor profile.

A randomised controlled trial, evaluating the effectiveness of a Canadian community pharmacist-initiated risk assessment service for osteoporosis, reported a two-fold increase in the number of patients who were tested or treated for osteoporosis by their GPs.[54] This intervention, in addition to providing written educational materials, included a verbal educational component. Similarly, a study performed in the United States of America in patients with osteoporosis, which involved an educational intervention, showed a statistically significant increase in the participant awareness and intention to visit their GP for follow-up.[203] Another Canadian pharmacists' intervention for cholesterol risk management, where patients received education, showed GP referral uptake in 57% of referred participants.[206] All the above observations indicate the need to include a verbal educational component within the CKD risk assessment service. It is crucial that community pharmacists, during their training, are instructed on the importance of providing patients with education on several aspects of CKD. More specifically, patients need to understand the asymptomatic nature of CKD, and

importance of a regular 'Kidney Health Check'. Consequently, if patients' understanding is improved, then it is possible that more participants would become proactive in initiating a discussion on their risk results with their GP, which would lead to an improved GP referral uptake and further investigation.

During training, pharmacists should also be made aware of the strategy of integrating the CKD service with other established pharmacy services. A systematic review examining the pharmacy customers' attitudes towards public health promotion services found that customers still perceived the role of community pharmacists to be mainly medicine related and did not expect to be offered other extended services.[127] However, this review additionally found high customer satisfaction in those who had experienced these extended services. In a recent atrial fibrillation screening study, pharmacists reported combining services to offer a CVD screening package, while performing medications review as a more attractive package for customers.[139] Pharmacists interviewed within Project II (C) similarly observed an increase in the CKD service uptake when it was combined with other pharmacy services such as medications review and diabetes management, for which pharmacists carry credibility. Hence, if customers are offered combined services then it could result in dual advantages: 1. Improved customer participation; and 2. Increased uptake of important, less familiar services.

Workflow challenges, specifically insufficient time, were identified as another important barrier towards effective implementation of the CKD service. Pharmacy staff are often the first point of contact, and generally trained to offer several professional services to pharmacy customers.[127] Up-skilling pharmacy staff to primarily engage customers and perform the initial stages of screening could help to reduce the pharmacists' time burden.[139] Increased customer response to the CKD service was also observed by few pharmacists within Project II (C) when they implemented this strategy. Pharmacists should therefore be instructed to train pharmacy

staff to identify eligible customers for recruitment, perform the initial participant demographic and clinical data collection, and measure height and weight. This would allow pharmacists to focus on key aspects of the risk assessment protocol and educating consumers.

Lastly, pharmacists should be self-confident in promoting and delivering the CKD service to their customers. This is mainly because findings from Project II (C) and other studies[114, 134-138] have shown that pharmacy customers generally still do not perceive disease prevention to be the role of community pharmacists. Also, although not identified as a barrier in our projects, a systematic review has shown pharmacists' confidence in providing public health services as being only average to low.[127]

Evaluation of our final (Project III) revealed that the Australian public knowledge of the physiological role of the kidneys, CKD and its risk factors was limited, irrespective of sociodemographic and clinical characteristics. These findings further suggest that pharmacists should not feel intimidated when discussing about CKD with their customers. Evaluation of project III results also emphasise the importance of improving the public understanding of kidneys and knowledge on CKD through nationwide awareness campaigns. This is particularly necessary because limited knowledge about CKD will prevent the public from engaging in any CKD associated screening and preventive interventions.

The cost of providing each CKD risk assessment is approximately AUD$10, based primarily on the pharmacist time required. Approximately 50% of the respondents under Project II (D) indicated that they would pay at least this amount for risk assessment. Additionally, integrating CKD risk assessment with other services commonly used by pharmacy customers would make it more attractive, and consequently, more customers would be willing to pay. Currently, poor awareness of CKD amongst the Australian public also acts as a barrier; however, if this is

addressed, then the likelihood of pharmacists being remunerated either by the customer or government may improve.

Conclusion

Despite the significant burden of CKD, at present, healthcare policies and funding to support the interventions for 'Early detection and prevention of CKD' do not exist in Australia. To our knowledge, this is the first study performed in Australia which implemented and evaluated the effectiveness of a CKD risk assessment service in the community pharmacy setting. The work performed in this thesis shows that community pharmacists possess appropriate knowledge and skills to provide a targeted CKD risk assessment service. Also, community pharmacies could serve as a useful setting for implementing targeted CKD screening interventions. However, the implemented CKD risk assessment protocol had limitations, and requires several refinements. Future implementation and evaluation of the refined protocol would help to establish the true effectiveness of this service.

References

1. Mills KT, Xu Y, Zhang W, Bundy JD, Chen CS, Kelly TN, et al. A systematic analysis of worldwide population-based data on the global burden of chronic kidney disease in 2010. Kidney Int. 2015;88(5):950-7.

2. Naghavi M, Wang H, Lozano R, Davis A, Liang X, Zhou M, et al. Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: A systematic analysis for the Global Burden of Disease Study 2013. The Lancet. 2015;385(9963):117-71.

3. Australian Bureau of Statistics. Australian Health Survey: Biomedical results for Chronic Diseases, 2011-2012. 2013. Last accessed: 1 August 2017. Available from: http://www.abs.gov.au/websitedbs/D3310114.nsf/home/home?opendocument#from-banner=GT.

4. Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group. KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. Kidney Int Suppl. 2013;3(1):1-163.

5. Chronic Kidney Disease (CKD) Management in General Practice. Guidance and clinical tips to help identify, manage and refer patients with CKD in your practice (3rd edition). Kidney Health Australia, Melbourne. Australia: Kidney Health Australia; 2015. Last accessed: 12 April 2017. Available from: http://www.kidney.org.au/.

6. Johnson DW, Atai E, Chan M, Phoon RK, Scott C, Toussaint ND, et al. KHA-CARI guideline: Early chronic kidney disease: detection, prevention and management. Nephrology (Carlton, Vic). 2013;18(5):340-50.

7. Weiner DE. Public health consequences of chronic kidney disease. Clin Pharmacol Ther. 2009;86(5):566-9.

8. Levey AS, Coresh J, Balk E, Kausz AT, Levin A, Steffes MW, et al. National Kidney Foundation practice guidelines for chronic kidney disease: evaluation, classification, and stratification. Ann Intern Med. 2003;139(2):137-47.

9. Jha V, Garcia-Garcia G, Iseki K, Li Z, Naicker S, Plattner B, et al. Chronic kidney disease: Global dimension and perspectives. The Lancet. 2013;382(9888):260-72.

10. Webster AC, Nagler EV, Morton RL, Masson P. Chronic Kidney Disease. Lancet. 2017;389(10075):1238-52.

11. Mathew T, Corso O. Review article: Early detection of chronic kidney disease in Australia: which way to go? Nephrology (Carlton, Vic). 2009;14(4):367-73.

12. Razavian M, Heeley EL, Perkovic V, Zoungas S, Weekes A, Patel AA, et al. Cardiovascular risk management in chronic kidney disease in general practice (the AusHEART study). Nephrol Dial Transplant. 2012;27(4):1396-402.

13. Australian Institute of Health and Welfare. Dialysis and kidney transplantation in Australia: 1991–2010. Cat. no. PHE 162. Canberra: AIHW. 2012. Last accessed: [cited 2017 May 26]. Available from: Available from: http://www.aihw.gov.au/.

14. Keith DS, Nichols GA, Gullion CM, Brown JB, Smith DH. Longitudinal follow-up and outcomes among a population with chronic kidney disease in a large managed care organization. Arch Intern Med. 2004;164(6):659-63.

15. Cass A, Chadban S, Gallagher M. Kidney Health Australia. The economic impact of end-stage kidney disease in Australia: Projections to 2020. 2010. Last accessed: 8 March 2017. Available from: http://kidney.org.au/cms_uploads/docs/kha-economic-impact-of-eskd-in-australia-projections-2020.pdf.

16. Coresh J, Selvin E, Stevens LA, Manzi J, Kusek JW, Eggers P, et al. Prevalence of chronic kidney disease in the United States. JAMA. 2007;298(17):2038-47.

17. ANZDATA Registry. 39th Annual Report. Incidence of End Stage Kidney Disease.: Australia and New Zealand Dailysis and Transplant Registry, Adelaide, Australia; 2016. Last accessed: 21 March 2017. Available from: http://www.anzdata.org.au/.

18. McCullough K, Sharma P, Ali T, Khan I, Smith WC, MacLeod A, et al. Measuring the population burden of chronic kidney disease: a systematic literature review of the estimated prevalence of impaired kidney function. Nephrol Dial Transplant. 2012;27(5):1812-21.

19. Denekamp Y. Clinical decision support systems for addressing information needs of physicians. Isr Med Assoc J. 2007;9(11):771-6.

20. Fox CH, Brooks A, Zayas LE, McClellan W, Murray B. Primary care physicians' knowledge and practice patterns in the treatment of chronic kidney disease: an Upstate New York Practice-based Research Network (UNYNET) study. J Am Board Fam Med. 2006;19(1):54-61.

21. Nagykaldi Z, Mold JW, Aspy CB. Practice facilitators: a review of the literature. Fam Med. 2005;37(8):581-8.

22. Nagykaldi Z, Mold JW, Robinson A, Niebauer L, Ford A. Practice facilitators and practice-based research networks. J Am Board Fam Med. 2006;19(5):506-10.

23. Cantu TG, Ellerbeck EF, Yun SW, Castine SD, Kornhauser DM. Drug prescribing for patients with changing renal function. Am J Hosp Pharm. 1992;49(12):2944-8.

24. Hu KT, Matayoshi A, Stevenson FT. Calculation of the estimated creatinine clearance in avoiding drug dosing errors in the older patient. Am J Med Sci. 2001;322(3):133-6.

25. Long CL, Raebel MA, Price DW, Magid DJ. Compliance with dosing guidelines in patients with chronic kidney disease. Ann Pharmacother. 2004;38(5):853-8.

26. Papaioannou A, Clarke JA, Campbell G, Bedard M. Assessment of adherence to renal dosing guidelines in long-term care facilities. J Am Geriatr Soc. 2000;48(11):1470-3.

27. Yap C, Dunham D, Thompson J, Baker D. Medication dosing errors for patients with renal insufficiency in ambulatory care. Joint Commission journal on quality and patient safety / Joint Commission Resources. 2005;31(9):514-21.

28. Fink JC, Joy MS, St Peter WL, Wahba IM. Finding a common language for patient safety in CKD. Clin J Am Soc Nephrol. 2012;7(4):689-95.

29. Breton G, Froissart M, Janus N, Launay-Vacher V, Berr C, Tzourio C, et al. Inappropriate drug use and mortality in community-dwelling elderly with impaired kidney function--the Three-City population-based study. Nephrol Dial Transplant. 2011;26(9):2852-9.

30. ANZDATA Registry. 38th Report, Chapter 2: Prevalence of End Stage Kidney Disease.: Australia and New Zealand Dialysis and Transplant Registry, Adelaide, Australia; 2016. Last accessed: 14 March 2017. Available from: http://www.anzdata.org.au/.

31. Akbari A, Swedko PJ, Clark HD, Hogg W, Lemelin J, Magner P, et al. Detection of chronic kidney disease with laboratory reporting of estimated glomerular filtration rate and an educational program. Arch Intern Med. 2004;164(16):1788-92.

32. Greer RC, Powe NR, Jaar BG, Troll MU, Boulware LE. Effect of primary care physicians' use of estimated glomerular filtration rate on the timing of their subspecialty referral decisions. BMC Nephrol. 2011;12(1):1.

33. Rothberg MB, Kehoe ED, Courtemanche AL, Kenosi T, Pekow PS, Brennan MJ, et al. Recognition and management of chronic kidney disease in an elderly ambulatory population. J Gen Intern Med. 2008;23(8):1125-30.

34. Jose MD, Otahal P, Kirkland G, Blizzard L. Chronic kidney disease in Tasmania. Nephrology (Carlton, Vic). 2009;14(8):743-9.

35. Pefanis A, Botlero R, Langham RG, Nelson CL. eMAP:CKD: electronic diagnosis and management assistance to primary care in chronic kidney disease. Nephrol Dial Transplant. 2016;pii: gfw366. [Epub ahead of print].

36. Mathew TH, Corso O, Ludlow M, Boyle A, Cass A, Chadban SJ, et al. Screening for chronic kidney disease in Australia: a pilot study in the community and workplace. Kidney Int Suppl. 2010;77(Suppl 116):S9-16.

37. Ampt AJ, Amoroso C, Harris MF, McKenzie SH, Rose VK, Taggart JR. Attitudes, norms and controls influencing lifestyle risk factor management in general practice. BMC Fam Pract. 2009;10(1):59.

38. Considine R., Tozer J., Milne H., M. C. Australian Government The Department of Health. Evaluation of the GP Super Clinics Program 2007-2008. 2011. Last accessed: 21 August 2017. Available from: http://www.health.gov.au/internet/publications/publishing.nsf/Content/GPSuperClinicsEvaluation-toc.

39. Booth AO, Nowson CA. Patient recall of receiving lifestyle advice for overweight and hypertension from their General Practitioner. BMC Fam Pract. 2010;11(1):8.

40. Sinclair PM, Day J, Levett-Jones T, Kable A. Barriers and facilitators to opportunistic chronic kidney disease screening by general practice nurses. Nephrology. 2017;22(10):776-82.

41. Dhippayom T, Fuangchan A, Tunpichart S, Chaiyakunapruk N. Opportunistic screening and health promotion for type 2 diabetes: an expanding public health role for the community pharmacist. Journal of public health (Oxford, England). 2013;35(2):262-9.

42. Thoopputra T, Pongmesa T, Newby DA, Schneider J, Li SC. Opportunistic Risk Screening for Type 2 Diabetes: Exploring of Application of Diabetes Risk Assessment Tool in Community Pharmacy in Australia and Thailand. Value Health Reg Issues. 2016;9(Supplement C):1-7.

43. Krass I, Mitchell B, Clarke P, Brillant M, Dienaar R, Hughes J, et al. Pharmacy diabetes care program: analysis of two screening methods for undiagnosed type 2 diabetes in Australian community pharmacy. Diabetes Res Clin Pract. 2007;75(3):339-47.

44. Peterson GM, Fitzmaurice KD, Kruup H, Jackson SL, Rasiah RL. Cardiovascular risk screening program in Australian community pharmacies. Pharm World Sci. 2010;32(3):373-80.

45. Cerulli J, Zeolla MM. Impact and feasibility of a community pharmacy bone mineral density screening and education program. J Am Pharm Assoc (2003). 2004;44(2):161-7.

46. Goode JV, Swiger K, Bluml BM. Regional osteoporosis screening, referral, and monitoring program in community pharmacies: findings from Project ImPACT: Osteoporosis. J Am Pharm Assoc (2003). 2004;44(2):152-60.

47. Lowres N, Neubeck L, Salkeld G, Krass I, McLachlan AJ, Redfern J, et al. Feasibility and cost-effectiveness of stroke prevention through community screening for atrial fibrillation using iPhone ECG in pharmacies. The SEARCH-AF study. Thromb Haemost. 2014;111(6):1167-76.

48. Willis A, Rivers P, Gray LJ, Davies M, Khunti K. The Effectiveness of Screening for Diabetes and Cardiovascular Disease Risk Factors in a Community Pharmacy Setting. PLoS One. 2014;9(4):e91157.

49. Pourrat X, Sipert AS, Gatault P, Sautenet B, Hay N, Guinard F, et al. Community pharmacist intervention in patients with renal impairment. Int J Clin Pharm. 2015;37(6):1172-9.

50. Geerts AF, De Koning FH, De Vooght KM, Egberts AC, De Smet PA, van Solinge WW. Feasibility of point-of-care creatinine testing in community pharmacy to monitor drug therapy in ambulatory elderly patients. J Clin Pharm Ther. 2013;38(5):416-22.

51. Al Hamarneh YN, Hemmelgarn B, Curtis C, Balint C, Jones CA, Tsuyuki RT. Community pharmacist targeted screening for chronic kidney disease. Can Pharm J (Ott). 2016;149(1):13-7.

52. My Health Record, Australian Digital Health Agency, Australian Government 2017. Last accessed: 29 December 2017.

53. Blenkinsopp A, Anderson C, Armstrong M. Systematic review of the effectiveness of community pharmacy-based interventions to reduce risk behaviours and risk factors for coronary heart disease. J Public Health Med. 2003;25(2):144-53.

54. Yuksel N, Majumdar SR, Biggs C, Tsuyuki RT. Community pharmacist-initiated screening program for osteoporosis: randomized controlled trial. Osteoporos Int. 2010;21(3):391-8.

55. QKidney®-2016 risk calculator. United Kingdom: ClinRisk Ltd; 2010-2017 updated 2017 2017 April 15. Last accessed: 15 April 2017. Available from: http://www.qkidney.org/index.php.

56. Collins G, Altman D. Predicting the risk of chronic kidney disease in the UK: an evaluation of QKidney(R) scores using a primary care database. Br J Gen Pract. 2012;62(597):e243-50.

57. Halbesma N, Jansen DF, Heymans MW, Stolk RP, de Jong PE, Gansevoort RT. Development and validation of a general population renal risk score. Clin J Am Soc Nephrol. 2011;6(7):1731-8.

58. Hippisley-Cox J, Coupland C. Predicting the risk of chronic Kidney Disease in men and women in England and Wales: prospective derivation and external validation of the QKidney Scores. BMC Fam Pract. 2010;11(1):49.

59. O'Seaghdha CM, Lyass A, Massaro JM, Meigs JB, Coresh J, D'Agostino RB, Sr., et al. A risk score for chronic kidney disease in the general population. Am J Med. 2012;125(3):270-7.

60. Taal MW, Brenner BM. Predicting initiation and progression of chronic kidney disease: Developing renal risk scores. Kidney Int. 2006;70(10):1694-705.

61. Hippisley-Cox J, Coupland C, Brindle P. The performance of seven QPrediction risk scores in an independent external sample of patients from general practice: a validation study. BMJ Open. 2014;4(8):e005809.

62. Smart NA, Titus TT. Outcomes of early versus late nephrology referral in chronic kidney disease: a systematic review. Am J Med. 2011;124(11):1073-80.e2.

63. Lopez-Vargas PA, Tong A, Sureshkumar P, Johnson DW, Craig JC. Prevention, detection and management of early chronic kidney disease: a systematic review of clinical practice guidelines. Nephrology (Carlton, Vic). 2013;18(9):592-604.

64. Komenda P, Ferguson TW, Macdonald K, Rigatto C, Koolage C, Sood MM, et al. Cost-effectiveness of primary screening for CKD: A systematic review. Am J Kidney Dis. 2014;63(5):789-97.

65. Bang H, Vupputuri S, Shoham DA, Klemmer PJ, Falk RJ, Mazumdar M, et al. SCreening for Occult REnal Disease (SCORED): a simple prediction model for chronic kidney disease. Arch Intern Med. 2007;167(4):374-81.

66. De Almeida EAF, Lavinas C, Teixeira C, Raimundo M, Nogueira C, João Melo M, et al. Evaluation of an instrument for screening patients at risk for chronic kidney disease: Testing SCORED (screening for occult renal disease) in a Portuguese population. Kidney Blood Press Res. 2012;35(6):568-72.

67. Brown WW, Peters RM, Ohmit SE, Keane WF, Collins A, Chen SC, et al. Early detection of kidney disease in community settings: The kidney early evaluation program (KEEP). Am J Kidney Dis. 2003;42(1):22-35.

68. McGill JB, Brown WW, Chen SC, Collins AJ, Gannon MR. Kidney Early Evaluation Program (KEEP). Findings from a community screening program. Diabetes Educ. 2004;30(2):196-8, 200-2, 6.

69. Collins AJ, Li S, Chen SC, Vassalotti JA. Participant Follow-up in the Kidney Early Evaluation Program (KEEP) After Initial Detection. Am J Kidney Dis. 2008;51(4 SUPPL. 2):S69-S76.

70. Jurkovitz CT, Qiu Y, Wang C, Gilbertson DT, Brown WW. The Kidney Early Evaluation Program (KEEP): program design and demographic characteristics of the population. Am J Kidney Dis. 2008;51(4 Suppl 2):S3-12.

71. Harward DH, Bomback AS, Jennette CE, Amamoo MA, Falk R. The Kidney Education Outreach Program's community-based screenings: participants' demographics and screening results. N C Med J. 2009;70(6):507-12.

72. Obrador GT, García-García G, Villa AR, Rubilar X, Olvera N, Ferreira E, et al. Prevalence of chronic kidney disease in the Kidney Early Evaluation Program (KEEP) México and comparison with KEEP US. Kidney Int Suppl. 2010(116):S2-8.

73. National Kidney Foundation. American Journal of Kidney Disease-KEEP 2012 Annual Data Reports. Summary Figures, Reference Tables, and Analytical Methods. 2012. Last accessed: 26 April 2017. Available from: https://www.kidney.org/news/keep/KEEPDataReports.

74. Barahimi H, Aghighi M, Aghayani K, Foroushani AR. Chronic kidney disease management program in Shahreza, Iran. Iranian J Kidney Dis. 2014;8(6):450-6.

75. Galbraith LE, Ronksley PE, Barnieh LJ, Kappel J, Manns BJ, Samuel SM, et al. The See Kidney Disease Targeted Screening Program for CKD. Clin J Am Soc Nephrol. 2016;11(6):964-72.

76. Brown WW, Collins A, Chen SC, King K, Molony D, Gannon MR, et al. Identification of persons at high risk for kidney disease via targeted screening: the NKF Kidney Early Evaluation Program. Kidney Int Suppl. 2003(83):S50-5.

77. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Int J Surg. 2010;8(5):336-41.

78. Sterne JAC, Higgins JPT, Reeves BC. A Cochrane Risk of Bias Assessment Tool for Non-Randomized Studies of Interventions (ACROBAT-NRSI), Version1.0.0, 24 September 2014. Last accessed: 12 February 2016. Available from: http://www.riskofbias.info.

79. Berns JS. Routine screening for CKD should be done in asymptomatic adults … selectively. Clin J Am Soc Nephrol. 2014;9(11):1988-92.

80. Carroll MF, Temte JL. Proteinuria in adults: A diagnostic approach. Am Fam Physician. 2000;62(6):1333-40.

81. White SL, Polkinghorne KR, Atkins RC, Chadban SJ. Comparison of the prevalence and mortality risk of CKD in Australia using the CKD Epidemiology Collaboration (CKD-EPI) and Modification of Diet in Renal Disease (MDRD) Study GFR estimating equations: the AusDiab (Australian Diabetes, Obesity and Lifestyle) Study. Am J Kidney Dis. 2010;55(4):660-70.

82. Glassock RJ, Winearls C. Screening for CKD with eGFR: Doubts and dangers. Clin J Am Soc Nephrol. 2008;3(5):1563-8.

83. Rule AD, Bailey KR, Schwartz GL, Khosla S, Lieske JC, Melton LJ, 3rd. For estimating creatinine clearance measuring muscle mass gives better results than those based on demographics. Kidney Int. 2009;75(10):1071-8.

84. Benghanem Gharbi M, Elseviers M, Zamd M, Belghiti Alaoui A, Benahadi N, Trabelssi EH, et al. Chronic kidney disease, hypertension, diabetes, and obesity in the adult population of Morocco: how to avoid “over”- and “under”-diagnosis of CKD. Kidney International. 2016;89(6):1363-71.

85. Bruck K, Jager KJ, Dounousi E, Kainz A, Nitsch D, Arnlov J, et al. Methodology used in studies reporting chronic kidney disease prevalence: a systematic literature review. Nephrol Dial Transplant. 2016;31(4):680.

86. Glassock RJ. Is the presence of microalbuminuria a relevant marker of kidney disease? Curr Hypertens Rep. 2010;12(5):364-8.

87. Eriksen BO, Ingebretsen OC. The progression of chronic kidney disease: a 10-year population-based study of the effects of gender and age. Kidney Int. 2006;69(2):375-82.

88. Jaar BG, Khatib R, Plantinga L, Boulware LE, Powe NR. Principles of Screening for Chronic Kidney Disease. Clin J Am Soc Nephrol. 2008;3(2):601-9.

89. Ayorinde AA, Porteous T, Sharma P. Screening for major diseases in community pharmacies: a systematic review. Int J Pharm Pract. 2013;21(6):349-61.

90. Bereznicki BJ, Peterson G, Jackson S, Walters EH, George J, Stewart K, et al. Uptake and effectiveness of a community pharmacy intervention programme to improve asthma management. J Clin Pharm Ther. 2013;38(3):212-8.

91. Stafford L, Peterson GM, Bereznicki LR, Jackson SL, van Tienen EC, Angley MT, et al. Clinical outcomes of a collaborative, home-based postdischarge warfarin management service. Ann Pharmacother. 2011;45(3):325-34.

92. Williams M, Peterson GM, Tenni PC, Bindoff IK, Curtain C, Hughes J, et al. Drug-related problems detected in Australian Community Pharmacies: The PROMISe Trial. Ann Pharmacother. 2011;45(9):1067-76.

93. Benrimoj SI, Frommer MS. Community pharmacy in Australia. Aust Health Rev. 2004;28(2):238-46.

94. Salgado TM, Moles R, Benrimoj SI, Fernandez-Llimos F. Pharmacists' interventions in the management of patients with chronic kidney disease: a systematic review. Nephrol Dial Transplant. 2012;27(1):276-92.

95. Low BY, Halai HK. Exploring the roles of pharmacists in the prevention of chronic kidney disease: A qualitative study. Int J Pharm Pract. 2013;21(Suppl. 1):1-26.

96. Legris ME, Charbonneau-Séguin N, Desforges K, Sauvé P, Lord A, Bell R, et al. Quality of medication use in chronic kidney disease patients: Development and pilot testing of a web-based training program for community pharmacists. J Popul Ther Clin Pharmacol. 2011;18(2):e208.

97. Legris ME, Séguin NC, Desforges K, Sauvé P, Lord A, Bell R, et al. Pharmacist web-based training program on medication use in chronic kidney disease patients: Impact on knowledge, skills, and satisfaction. J Contin Educ Health Prof. 2011;31(3):140-50.

98. Lalonde L, Normandeau M, Lamarre D, Lord A, Berbiche D, Corneille L, et al. Evaluation of a training and communication-network nephrology program for community pharmacists. Pharm World Sci. 2008;30(6):924-33.

99. Abdel Shaheed C, Maher CG, Mak W, Williams KA, McLachlan AJ. The effects of educational interventions on pharmacists' knowledge, attitudes and beliefs towards low back pain. Int J Clin Pharm. 2015;37(4):616-25.

100. Jose J, Jimmy B, Al-Ghailani ASH, Al Majali MA. A cross sectional pilot study on assessing the knowledge, attitude and behavior of community pharmacists to adverse drug reaction related aspects in the Sultanate of Oman. Saudi Pharm J. 2014;22(2):163-9.

101. Smith SD, Lee A, Blaszczynski A, Fischer G. Pharmacists' knowledge about use of topical corticosteroids in atopic dermatitis: Pre and post continuing professional development education. Australas J Dermatol. 2016;57(3):199-204.

102. Sears KE, Cohen JE, Drope J. Comprehensive evaluation of an online tobacco control continuing education course in Canada. J Contin Educ Health Prof. 2008;28(4):235-40.

103. Abdulghani HM, Shaik SA, Khamis N, Al-Drees AA, Irshad M, Khalil MS, et al. Research methodology workshops evaluation using the Kirkpatrick's model: translating theory into practice. Med Teach. 2014;36(Suppl 1):S24-S9.

104. Kirkpatrick DL, Kirkpatrick JD. Evaluating Training Programs: The Four Levels. 3rd ed: Berrett-Koehler Publishers; 2009.

105. Pharmaceutical Society of Australia. Early Career Pharmacists. Early Career Pharmacists survey Appendix B - qualitative data. 2010. Last accessed: 2 December 2015. Available from: https://www.psa.org.au/about/ecp.

106. Gheewala PA, Zaidi STR, Jose MD, Bereznicki L, Peterson GM, Castelino RL. Effectiveness of targeted screening for chronic kidney disease in the community setting: a systematic review. Journal of nephrology. 2017:1-10.

107. The University of Adelaide. Hugo Centre for Migration and Population Research. Pharmacy Access/Remoteness Index of Australia. 2017. Last accessed: 22 August 2017. Available from: https://www.adelaide.edu.au/apmrc/research/projects/pharia/pharia-info.html.

108. Gheewala PA, Peterson GM, Zaidi ST, Bereznicki L, Jose MD, Castelino RL. A web-based training program to support chronic kidney disease screening by community pharmacists. Int J Clin Pharm. 2016;38(5):1080-6.

109. National Heart Foundation of Australia. Guideline for the diagnosis and management of hypertension in adults - 2016. Melbourne: National Heart Foundation of Australia; 2016. Last accessed: 15 March 2017. Available from: https://heartfoundation.org.au/for-professionals/clinical-information/hypertension.

110. Nichols M, Peterson K, Herbert J, Allender S. Australian heart disease statistics. Overweight, obesity and cardiovascular disease - past, present and future. Melbourne: National Heart Foundation of Australia; 2015. Last accessed: 23 April 2017. Available from: https://heartfoundation.org.au/images/uploads/publications/RES-114_Aust_HeartStats_Obesity_supplement.pdf.

111. Kidney Health Australia. Calculator & tools. QKidney® risk calculator. Australia: Kidney Health Australia; 2017. Last accessed: 29 May 2017. Available from: http://kidney.org.au/health-professionals/detect/calculator-and-tools.

112. Johnson DW, Jones GR, Mathew TH, Ludlow MJ, Doogue MP, Jose MD, et al. Chronic kidney disease and automatic reporting of estimated glomerular filtration rate: new developments and revised recommendations. Med J Aust. 2012;197(4):224-5.

113. Sandhu RK, Dolovich L, Deif B, Barake W, Agarwal G, Grinvalds A, et al. High prevalence of modifiable stroke risk factors identified in a pharmacy-based screening programme. Open Heart. 2016;3(2):e000515.

114. Bereznicki B, Peterson G, Jackson S, Haydn Walters E, DeBoos I, Hintz P. Perceived feasibility of a community pharmacy-based asthma intervention: a qualitative follow-up study. J Clin Pharm Ther. 2011;36(3):348-55.

115. Hersberger KE, Botomino A, Mancini M, Bruppacher R. Sequential screening for diabetes--evaluation of a campaign in Swiss community pharmacies. Pharm World Sci. 2006;28(3):171-9.

116. Lei Burton D, LeMay KS, Saini B, Smith L, Bosnic-Anticevich S, Southwell P, et al. The reliability and utility of spirometry performed on people with asthma in community pharmacies. J Asthma. 2015;52(9):913-9.

117. Armour C, Bosnic-Anticevich S, Brillant M, Burton D, Emmerton L, Krass I, et al. Pharmacy Asthma Care Program (PACP) improves outcomes for patients in the community. Thorax. 2007;62(6):496-502.

118. Sriram D, McManus A, Emmerton LM, Parsons RW, Jiwa M. A model for assessment and referral of clients with bowel symptoms in community pharmacies. Curr Med Res Opin. 2016;32(4):661-7.

119. Van C, Krass I, Mitchell B. General Practitioner Perceptions of Extended Pharmacy Services and Modes of Collaboration with Pharmacists. Journal of Pharmacy Practice and Research. 2007;37(3):182-6.

120. Bardet JD, Vo TH, Bedouch P, Allenet B. Physicians and community pharmacists collaboration in primary care: A review of specific models. Res Social Adm Pharm. 2015;11(5):602-22.

121. Löffler C, Koudmani C, Böhmer F, Paschka SD, Höck J, Drewelow E, et al. Perceptions of interprofessional collaboration of general practitioners and community pharmacists - a qualitative study. BMC Health Serv Res. 2017;17(1):224.

122. Blenkinsopp A, Bond C. Pharmacists must learn to play their part in multidisciplinary health teams. Pharm J. 2007;279(7470):330.

123. Benghanem Gharbi M, Elseviers M, Zamd M, Belghiti Alaoui A, Benahadi N, Trabelssi el H, et al. Chronic kidney disease, hypertension, diabetes, and obesity in the adult population of Morocco: how to avoid "over"- and "under"-diagnosis of CKD. Kidney Int. 2016;89(6):1363-71.

124. White SL, Polkinghorne KR, Cass A, Shaw J, Atkins RC, Chadban SJ. Limited knowledge of kidney disease in a survey of AusDiab study participants. Med J Aust. 2008;188(4):204-8.

125. Johnson DW. Evidence-based guide to slowing the progression of early renal insufficiency. Intern Med J. 2004;34(1-2):50-7.

126. Charting a comprehensive approach to tackling kidney disease. Pre-budget submission 2016-2017 Federal budget. Kidney Health Australia. 2017. Last accessed: [cited 2017 May 30]. Available from: Available from: http://kidney.org.au/.

127. Eades CE, Ferguson JS, O'Carroll RE. Public health in community pharmacy: A systematic review of pharmacist and consumer views. BMC Public Health. 2011;11(1):582.

128. Benrimoj SI, Roberts AS. Providing Patient Care in Community Pharmacies in Australia. Ann Pharmacother. 2005;39(11):1911-7.

129. Palinkas LA, Horwitz SM, Green CA, Wisdom JP, Duan N, Hoagwood K. Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. Admin Policy Ment Health. 2015;42(5):533-44.

130. Hsieh HF, Shannon SE. Three approaches to qualitative content analysis. Qual Health Res. 2005;15(9):1277-88.

131. Thomas DR. A General Inductive Approach for Analyzing Qualitative Evaluation Data. Am J Eval. 2006;27(2):237-46.

132. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. Int J Qual Health Care. 2007;19(6):349-57.

133. Weissenborn M, Haefeli WE, Peters-Klimm F, Seidling HM. Interprofessional communication between community pharmacists and general practitioners: a qualitative study. Int J Clin Pharm. 2017;39(3):495-506.

134. Twigg MJ, Poland F, Bhattacharya D, Desborough JA, Wright DJ. The current and future roles of community pharmacists: views and experiences of patients with type 2 diabetes. Res Social Adm Pharm. 2013;9(6):777-89.

135. Gidman W, Cowley J. A qualitative exploration of opinions on the community pharmacists' role amongst the general public in Scotland. Int J Pharm Pract. 2013;21(5):288-96.

136. Gastelurrutia MA, de San Vicente OG, Erauncetamurgil O, Odriozola I, Fernandez-Llimos F. Customers' expectations and satisfaction with a pharmacy not providing advanced cognitive services. Pharm World Sci. 2006;28(6):374-6.

137. Cavaco AM, Dias JP, Bates IP. Consumers' perceptions of community pharmacy in Portugal: a qualitative exploratory study. Pharm World Sci. 2005;27(1):54-60.

138. McMillan SS, Kelly F, Sav A, King MA, Whitty JA, Wheeler AJ. Consumer and carer views of Australian community pharmacy practice: awareness, experiences and expectations. J Pharm Health Serv Res. 2014;5(1):29-36.

139. Lowres N, Krass I, Neubeck L, Redfern J, McLachlan AJ, Bennett AA, et al. Atrial fibrillation screening in pharmacies using an iPhone ECG: a qualitative review of implementation. Int J Clin Pharm. 2015;37(6):1111-20.

140. Lucas B, Blenkinsopp A. Community pharmacists' experience and perceptions of the New Medicines Service (NMS). Int J Pharm Pract. 2015;23(6):399-406.

141. Cheong AT, Khoo EM, Tong SF, Liew SM. To Check or Not to Check? A Qualitative Study on How the Public Decides on Health Checks for Cardiovascular Disease Prevention. PLoS One. 2016;11(7):e0159438.

142. Guest G, Bunce A, Johnson L. How Many Interviews Are Enough? Field Methods. 2006;18(1):59-82.

143. Gudka S, Marshall L, Creagh A, Clifford RM. To develop and measure the effectiveness and acceptability of a pharmacy-based chlamydia screening intervention in Australia. BMJ Open. 2013;3(8):e003338.

144. Hersberger KE, Renggli VP, Nirkko AC, Mathis J, Schwegler K, Bloch KE. Screening for sleep disorders in community pharmacies – evaluation of a campaign in Switzerland. J Clin Pharm Ther. 2006;31(1):35-41.

145. Breslow RM. Patient attitudes regarding pharmacist-administered memory screening in community pharmacies. J Am Pharm Assoc (2003). 2013;53(6):648-51.

146. Naik Panvelkar P, Saini B, Armour C. Measurement of patient satisfaction with community pharmacy services: a review. Pharm World Sci. 2009;31(5):525-37.

147. MacKeigan LD, Larson LN. Development and validation of an instrument to measure patient satisfaction with pharmacy services. Med Care. 1989;27(5):522-36.

148. Krass I, Delaney C, Glaubitz S, Kanjanarach T. Measuring patient satisfaction with diabetes disease state management services in community pharmacy. Res Social Adm Pharm. 2009;5(1):31-9.

149. Butler KT, Ruisinger JF, Bates J, Prohaska ES, Melton BL. Participant satisfaction with a community-based medication synchronization program. J Am Pharm Assoc (2003). 2015;55(5):534-9.

150. Tinelli M, Blenkinsopp A, Bond C. Development, validation and application of a patient satisfaction scale for a community pharmacy medicines-management service. Int J Pharm Pract. 2011;19(3):144-55.

151. Paddock LE, Veloski J, Chatterton ML, Gevirtz FO, Nash DB. Development and validation of a questionnaire to evaluate patient satisfaction with diabetes disease management. Diabetes Care. 2000;23(7):951-6.

152. Toh LS, Lai PSM, Wu DB-C, Wong KT, Low BY, Tan ATB, et al. The development and validation of the Satisfaction Questionnaire for Osteoporosis Prevention in Malaysia. Patient Prefer Adherence. 2014;8:1365-81.

153. Suh DC. Consumers' willingness to pay for pharmacy services that reduce risk of medication-related problems. J Am Pharm Assoc (Wash). 2000;40(6):818-27.

154. Daftary MN, Lee E, Dutta AP, Olagundoye A, Xue Z. Patients' Willingness to Pay for Cognitive Pharmacy Services in Ambulatory Care Settings in the USA. Journal of Pharmacy Practice and Research. 2003;33(4):265-7.

155. Barner JC, Branvold A. Patients' willingness to pay for pharmacist-provided menopause and hormone replacement therapy consultations. Res Social Adm Pharm. 2005;1(1):77-100.

156. Vos T, Barber RM, Bell B, Bertozzi-Villa A, Biryukov S, Bolliger I, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. The Lancet. 2013;386(9995):743-800.

157. K/DOQI clinical practice guidelines for chronic kidney disease: evaluation, classification, and stratification. Am J Kidney Dis. 2002;39(2 Suppl 1):S1-266.

158. Jordan JE, Briggs AM, Brand CA, Osborne RH. Enhancing patient engagement in chronic disease self-management support initiatives in Australia: the need for an integrated approach. Med J Aust. 2008;189(10 Suppl):S9-S13.

159. Moore K, Smith BJ, Reilly K. Community understanding of the preventability of major health conditions as a measure of health literacy. Aust J Rural Health. 2013;21(1):35-40.

160. Smith B, Sullivan E, Bauman A, Powell-Davies G, Mitchell J. Lay beliefs about the preventability of major health conditions. Health Educ Res. 1999;14(3):315-25.

161. Adult Literacy And Skills Survey, Summary Results Australia. Australian Bureau of Statistics. 2008. Last accessed: 1 March 2017. Available from: https://www.ala.asn.au/wp-content/uploads/research/ADULT_LITERACY_AND_LIFE_SKILLS.pdf.

162. Chen T, Harris DC. Challenges of chronic kidney disease prevention. Med J Aust. 2015;203(5):209-10.

163. Glanz K, Bishop DB. The role of behavioral science theory in development and implementation of public health interventions. Annu Rev Public Health. 2010;31:399-418.

164. Schoolwerth AC, Engelgau MM, Rufo KH, Vinicor F, Hostetter TH, Chianchiano D, et al. Chronic Kidney Disease: A Public Health Problem That Needs a Public Health Action Plan. Prev Chronic Dis. 2006;3(2):A57.

165. Chow KM, Szeto CC, Kwan B, Leung CB, Li PK. Public lacks knowledge on chronic kidney disease: telephone survey. Hong Kong Med J. 2014;20(2):139-44.

166. Roomizadeh P, Taheri D, Abedini A, Mortazavi M, Larry M, Mehdikhani B, et al. Limited knowledge of chronic kidney disease and its main risk factors among Iranian community: an appeal for promoting national public health education programs. Int J Health Policy Manag. 2014;2(4):161-6.

167. Oluyombo R, Ayodele OE, Akinwusi PO, Okunola OO, Gbadegesin BA, Soje MO, et al. Awareness, knowledge and perception of chronic kidney disease in a rural community of South-West Nigeria. Niger J Clin Pract. 2016;19(2):161-9.

168. Wright JA, Wallston KA, Elasy TA, Ikizler TA, Cavanaugh KL. Development and results of a kidney disease knowledge survey given to patients with CKD. Am J Kidney Dis. 2011;57(3):387-95.

169. Johnson ML, Zimmerman L, Welch JL, Hertzog M, Pozehl B, Plumb T. Patient activation with knowledge, self-management and confidence in chronic kidney disease. Journal of renal care. 2016;42(1):15-22.

170. Burke MT, Kapojos J, Sammartino C, Gray NA. Kidney disease health literacy among new patients referred to a nephrology outpatient clinic. Intern Med J. 2014;44(11):1080-6.

171. Gray NA, Kapojos JJ, Burke MT, Sammartino C, Clark CJ. Patient kidney disease knowledge remains inadequate with standard nephrology outpatient care. Clinical kidney journal. 2016;9(1):113-8.

172. Cavanaugh KL, Osborn CY, Tentori F, Rothman RL, Ikizler TA, Wallston KA. Performance of a brief survey to assess health literacy in patients receiving hemodialysis. Clinical kidney journal. 2015;8(4):462-8.

173. Australian Institute of Health and Welfare 2015. Cardiovascular disease, diabetes and chronic kidney disease-Australian facts: Risk factors. Cardiovascular, diabetes and chronic kidney disease series no. 4. Cat. no. CDK 4. Canberra: AIHW.: Australian Institute of Health and Welfare; 2015. Last accessed: 26 February 2017. Available from: http://www.aihw.gov.au/ckd-publications/.

174. Viechtbauer W, Smits L, Kotz D, Bude L, Spigt M, Serroyen J, et al. A simple formula for the calculation of sample size in pilot studies. J Clin Epidemiol. 2015;68(11):1375-9.

175. Cohen J. Statistical Power Analysis for the Behavioural Sciences. 2nd ed. Hillsdale, NJ, United States: Lawrence Erlbaum Associates; 1988.

176. I-view Pty Ltd. Australia's leading market and social research data collection agency. Online Omnibus service. 2013. Last accessed: 9 January 2017. Available from: http://www.iview.com.au/default.aspx.

177. Valliant RD, J. A.; Kreuter, F. Practical tools for designing and weighting survey samples: Springer, New York.; 2013.

178. Tijms H. Understanding Probability. 3rd ed. United States of America: Cambridge University Press, New York; 2012.

179. Jha V. Herbal medicines and chronic kidney disease. Nephrology (Carlton, Vic). 2010;15(Suppl 2):10-7.

180. Tangkiatkumjai M, Boardman H, Praditpornsilpa K, Walker DM. Association of herbal and dietary supplements with progression and complications of chronic kidney disease: A prospective cohort study. Nephrology (Carlton, Vic). 2015;20(10):679-87.

181. Rosenkranz B, Fasinu P, Bouic P. An Overview of the Evidence and Mechanisms of Herb–Drug Interactions. Front Pharmacol. 2012;3(69).

182. Li J, Berkowitz Z, Richards TB, Richardson LC. Shared Decision Making in Prostate-Specific Antigen Testing With Men Older Than 70 Years. J Am Board Fam Med. 2013;26(4):401-8.

183. Begashaw B, Tessema F, Gesesew HA. Health Care Seeking Behavior in Southwest Ethiopia. PLoS One. 2016;11(9):e0161014.

184. Chen Y, Sun G, Guo X, Chen S, Chang Y, Li Y, et al. Factors affecting the quality of life among Chinese rural general residents: a cross-sectional study. Public Health. 2017;146:140-7.

185. Streiner DL, Norman RG. Health Measurement Scales: A practical guide to their development and use. 4th ed. Oxford New York: Oxford University Press; 2008.

186. Boynton PM, Greenhalgh T. Selecting, designing, and developing your questionnaire. BMJ. 2004;328(7451):1312-5.

187. DeVon HA, Block ME, Moyle-Wright P, Ernst DM, Hayden SJ, Lazzara DJ, et al. A psychometric toolbox for testing validity and reliability. J Nurs Scholarsh. 2007;39(2):155-64.

188. DeVellis R, F. Scale Development: Theory and Applications. 3rd ed. Thousand Oaks, California: SAGE; 2003.

189. Duban L, Fazekas T, Fulmekova M, Snopkova M, Olearova A, Kuzelova M. Identifying the interprofessional agreement between community pharmacists and general practitioners views on collaborative practice in Slovakia. Ceska Slov Farm. 2017;66(2):67-75.

190. Van C, Costa D, Abbott P, Mitchell B, Krass I. Community pharmacist attitudes towards collaboration with general practitioners: development and validation of a measure and a model. BMC Health Serv Res. 2012;12:320.

191. Kelly DV, Bishop L, Young S, Hawboldt J, Phillips L, Keough TM. Pharmacist and physician views on collaborative practice: Findings from the community pharmaceutical care project. Can Pharm J (Ott). 2013;146(4):218-26.

192. Snyder ME, Zillich AJ, Primack BA, Rice KR, Somma McGivney MA, Pringle JL, et al. Exploring successful community pharmacist-physician collaborative working relationships using mixed methods. Res Social Adm Pharm. 2010;6(4):307-23.

193. Carter BL, Bergus GR, Dawson JD, Farris KB, Doucette WR, Chrischilles EA, et al. A cluster randomized trial to evaluate physician/pharmacist collaboration to improve blood pressure control. J Clin Hypertens (Greenwich). 2008;10(4):260-71.

194. Carter BL, Ardery G, Dawson JD, James PA, Bergus GR, Doucette WR, et al. Physician and pharmacist collaboration to improve blood pressure control. Arch Intern Med. 2009;169(21):1996-2002.

195. Farris KB, Cote I, Feeny D, Johnson JA, Tsuyuki RT, Brilliant S, et al. Enhancing primary care for complex patients. Demonstration project using multidisciplinary teams. Can Fam Physician. 2004;50:998-1003.

196. Liu Y, Doucette WR, Farris KB. Examining the development of pharmacist-physician collaboration over 3 months. Res Social Adm Pharm. 2010;6(4):324-33.

197. Brock KA, Doucette WR. Collaborative working relationships between pharmacists and physicians: an exploratory study. J Am Pharm Assoc (2003). 2004;44(3):358-65.

198. Bacci JL, Klepser D, Tilley H, Smith JK, Klepser ME. Community pharmacy-based point-of-care testing: A case study of pharmacist-physician collaborative working relationships. Res Social Adm Pharm. 2017;pii: S1551-7411(16)30591-5.

199. Nik J, Lai PSM, Ng CJ, Emmerton L. A qualitative study of community pharmacists' opinions on the provision of osteoporosis disease state management services in Malaysia. BMC Health Serv Res. 2016;16(1):448.

200. Liu Y, Doucette WR. Exploring stages of pharmacist–physician collaboration using the model of collaborative working relationship. J Am Pharm Assoc (2003). 2011;51(3):412-9a.

201. Zillich AJ, McDonough RP, Carter BL, Doucette WR. Influential characteristics of physician/pharmacist collaborative relationships. Ann Pharmacother. 2004;38(5):764-70.

202. Doucette WR, Nevins J, McDonough RP. Factors affecting collaborative care between pharmacists and physicians. Res Social Adm Pharm. 2005;1(4):565-78.

203. Law AV, Shapiro K. Impact of a community pharmacist-directed clinic in improving screening and awareness of osteoporosis. J Eval Clin Pract. 2005;11(3):247-55.

204. Zillich AJ, Milchak JL, Carter BL, Doucette WR. Utility of a questionnaire to measure physician-pharmacist collaborative relationships. J Am Pharm Assoc (2003). 2006;46(4):453-8.

205. Tricco AC, Ivers NM, Grimshaw JM, Moher D, Turner L, Galipeau J, et al. Effectiveness of quality improvement strategies on the management of diabetes: a systematic review and meta-analysis. Lancet. 2012;379(9833):2252-61.

206. Tsuyuki RT, Johnson JA, Teo KK, Simpson SH, Ackman ML, Biggs RS, et al. A randomized trial of the effect of community pharmacist intervention on cholesterol risk management: the Study of Cardiovascular Risk Intervention by Pharmacists (SCRIP). Arch Intern Med. 2002;162(10):1149-55.

Appendix

Appendix 1 PROJECT I

CHAPTER 1. Effectiveness of Targeted Screening Programs for Detection, Prevention and Management of Early Chronic Kidney Disease in community-settings: A Systematic Review

Appendix 1.1 Systematic review protocol

PROSPERO International prospective register of systematic reviews

Effectiveness of targeted screening for early detection of chronic kidney disease in the community setting: a systematic review

Pankti Gheewala, Gregory Peterson, Tabish Zaidi, Luke Bereznicki, Matthew Jose, Ronald Castelino

Citation
Pankti Gheewala, Gregory Peterson, Tabish Zaidi, Luke Bereznicki, Matthew Jose, Ronald Castelino. Effectiveness of targeted screening for early detection of chronic kidney disease in the community setting: a systematic review. PROSPERO 2016: CRD42016037204

Available from:
http://www.crd.york.ac.uk/PROSPERO_REBRANDING/display_record.asp?ID=CRD42016037204

Review question(s)
Can targeted screening effectively identify undiagnosed patients with early stages of chronic kidney disease in the community-setting?
What study characteristics and screening tests should be used to ensure feasibility of a targeted screening program for chronic kidney disease?

Searches
Two search strategies will be used for this systematic review.
First, an electronic search of four databases: EMBASE, PubMed, Cochrane Central Register of Controlled Trials (CENTRAL) and Scopus will be conducted. Three layers of search terms (chronic kidney disease, screening and community) will be developed using the thesaurus (Emtree and Medical Subject Headings [MeSH] of EMBASE and PubMed, respectively). Wherever possible, the terms will be exploded to broaden the search or searched as a keyword in titles and abstracts of articles. Text word searching will also be conducted in order to identify any articles that may not have been indexed appropriately. The search terms will be modified for use across individual databases, due to the difference in their functionality.
For the second search strategy, reference lists of included studies or relevant reviews identified through the electronic search will be further scanned to identify any potential articles.
Publication date restrictions will not be applied to identify all relevant studies. Articles in language other than English will not be included in this review due to the lack of resources for translation services.

Types of study to be included
Inclusion criteria: Observational analytical studies (cross-sectional, case-control and prospective cohort) reporting the quantitative data and results of the screening tests will be included in this review.

Exclusion criteria: Studies that are retrospective in nature and of epidemiological design will be excluded from this review.

Condition or domain being studied

Globally, the incidence and prevalence of chronic kidney disease (CKD) is rising. Major health outcomes of CKD include complications of reduced kidney function (hypertension, anaemia, bone disease, electrolyte imbalance), end stage kidney disease (ESKD) and, cardiovascular disease (CVD). Evidence suggests that progression and adverse outcomes of CKD can be prevented or delayed by detecting and treating the disease in its initial stages 1-3. Unfortunately, CKD is asymptomatic until kidney function deteriorates by approximately 90%, which makes it challenging to detect the disease early. Hence, many clinical practice guidelines recommend that individuals with risk factors, such as hypertension, diabetes, CVD and a family history of kidney disease, should be regularly tested for
CKD. Worldwide, screening programs have been implemented in different community settings for high-risk patients.
Specifically, their objectives were to identify patients with evidence of CKD and refer them to healthcare professionals for diagnosis and management. The aim of this systematic review is to determine whether the targeted screening strategy is effective in identifying adult people with early stages of CKD in the community setting.

Participants/ population

Inclusion criteria: Adults (18 years or above) with one or more of the following medical history: diabetes, hypertension, CVD and family history of kidney disease.
Exclusion criteria: Adolescents (under 18 years of age).

Intervention(s), exposure(s)

For the purpose of this review, targeted screening program is defined as the implementation of test/s in people with risk factors of CKD.

1. Screening programs for this review are required to have targeted at least two CKD risk factors from the following: diabetes, hypertension, CVD and family history of kidney disease.
2. This review will consider screening programs implemented in any community setting (health centres, workplace, community centres, primary health care, outpatient clinics, community pharmacies etc.) by any health professional (nurse, pharmacist, physician, interns, residents etc.).
3. There will be no restrictions based on the length of follow-up of outcomes.
4. This review will include any screening tests that support early identification of CKD. These include: predictive algorithm, risk assessment tool, estimated glomerular filtration rate (eGFR), serum creatinine (SCr), proteinuria, albuminuria, albumin creatinine ratio (ACR), haematuria or blood pressure measurement.

Comparator(s)/ control

This is not applicable to studies included in this systematic review. All studies will be observational, analytical in nature.

Outcome(s)

Primary outcomes 1. Percentage of participants with positive screening test results

2. Participant referral rate
3. Percentage of participants consequently diagnosed with CKD
4. Screening tests used to detect evidence of CKD including: predictive algorithm, risk assessment tool, estimated glomerular filtration rate (eGFR), serum creatinine (SCr), proteinuria, albuminuria, albumin creatinine ratio (ACR), haematuria or blood pressure measurement.

Secondary outcomes

None

Data extraction, (selection and coding)

Screening of titles and abstracts of all articles retained through the search strategy will be performed by two reviewers independently. Full-texts of all articles will then be obtained from screened abstracts which appear to

be potentially relevant for inclusion. Again, this will be carried out independently by two reviewers and any disagreements for article selection will be discussed and resolved through mutual agreement.
Data extraction will be carried out by using a pre-prepared and pilot-tested data extraction form. The form will be developed using "The Cochrane Public Health Group Data Extraction and Assessment Template" as a reference and will include: study design type; community setting type; healthcare professional involved; participant demographics and characteristics; type of intervention and outcome measures. Where more than one publication from one screening program exists, all the results will be grouped together and the most recent or complete data set will be used in this systematic review. Disagreement between reviewers will be resolved by discussion; if no consensus can be reached, a third reviewer will be approached for assessment.

Risk of bias (quality) assessment
A Cochrane Risk of Bias Assessment Tool: for Non-Randomized Studies of Interventions (ACROBAT-NRSI) will be used for assessing the risk of bias of included articles. This tool covers seven domains through which bias might be introduced in quantitative studies. The first two domains will assess the risk of bias that can occur before initiation of the intervention; the third domain will assess the intervention itself; and the final four domains will assess for risk of bias that can arise after the intervention has been initiated. The assessment of risk of bias for all included studies will be independently undertaken by two reviewers and any disagreement will be resolved by using a third reviewer as an arbitrator.
Strategy for data synthesis
Dichotomous data (CKD evidence as indicated by positive screening test results, participant referral rate and CKD) will be evaluated using risk ratio (RR) with 95 % confidence interval (CI). Where continuous scales of measurement are used, the effects of intervention (tests such as eGFR, SCr, proteinuria, albuminuria, ACR etc.) will be analysed using weighted mean difference (with 95% CI) or standardised mean difference (with 95% CI) if different measurement scales have been used.
Data will be pooled only if the studies are of sufficient quality and contain methodologically and clinically comparable data. The decision to pool the data will be discussed between reviewers and performed only if consensus is reached. Heterogeneity will be analysed by examining the forest plots to detect overlap of CI and by using the Chi-square test (statistical significance level: 0.1). The I-squared statistic will be used for quantifying inconsistency across studies with values of 30% to 60%, 50% to 90% and 75% to 100% representing moderate, substantial and considerable levels of heterogeneity, respectively.
If quantitative data synthesis is not appropriate, then a systematic narrative synthesis will be provided. Characteristics and main findings of the included studies will be presented in the form of texts and/or tables.

Analysis of subgroups or subsets
None

Dissemination plans
The results of this systematic review will be published in a peer reviewed journal.

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Anticipated or actual start date 04 January 2016
Anticipated completion date 31 March 2017

Funding sources/sponsors None

Conflicts of interest None known

Language
English
Country
Australia
Subject index terms status
Subject indexing assigned by CRD
Subject index terms
Early Diagnosis; Humans; Renal Insufficiency, Chronic; Residence Characteristics
Stage of review
Ongoing
Date of registration in PROSPERO
01 April 2016
Date of publication of this revision
01 April 2016

Stage of review at time of this submission	Started	Completed
Preliminary searches	Yes	Yes
Piloting of the study selection process	Yes	Yes
Formal screening of search results against eligibility criteria	Yes	Yes
Data extraction	Yes	Yes
Risk of bias (quality) assessment	Yes	Yes
Data analysis	Yes	Yes

Appendix 1.2 Systematic review search strategy

Embase February 2016

No	Query	Results
#1	‘chronic kidney disease’/exp	43,096
#2	('chronic kidney' NEXT/1 (disease* OR disorder* OR function* OR insufficien*)):ab,ti	38,924
#3	(‘chronic renal’ NEXT/1 (disease* OR insufficienc*)):ab,ti	10,036
#4	'chronic nephropathy':ab,ti	453
#5	‘risk assessment’/exp	372453
#6	'early diagnosis'/exp	79817
#7	'early intervention'/exp	14589
#8	'health promotion'/exp	75951
#9	'primary prevention'/exp	30918
#10	‘screening’/exp	531426
#11	‘risk assessment’:ab,ti	49958
#12	'early diagnosis':ab,ti	81009
#13	'disease early detection':ab,ti	209
#14	'early medical intervention':ab,ti	132
#15	'health promotion':ab,ti	24736
#16	'wellness program':ab,ti	551
#17	'primary prevention':ab,ti	19611
#18	'screening':ab,ti	497460
#19	'workplace'/exp	28217
#20	‘community’/exp	74305
#21	('community' NEXT/1 (pharm* OR medicin* OR hospital*)):ab,ti	23675
#22	‘community health’ NEXT/1 (program* OR service* OR nurs* OR center* OR worker* OR clinic*)	7201
#23	'community':ab,ti	403047
#24	'workplace':ab,ti	30638
#25	#1 OR #2 OR #3 OR #4	60178
#26	#5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18	1328744
#27	#19 OR #20 OR #21 OR #22 OR #23 OR #24	454734
#28	#25 AND #26 AND #27	405
#29	#28 AND ('article'/it OR 'article in press'/it OR 'conference paper'/it)	266

PubMed January 2016

No	Query	Results
#1	"Renal Insufficiency, Chronic"[Mesh:NoExp]	9434
#2	chronic renal insufficienc*[Text Word]	13495
#3	chronic renal disease*[Text Word]	3263
#4	chronic kidney disease*[Text Word]	26795
#5	chronic kidney disorder*[Text Word]	20
#6	chronic kidney function[Text Word]	6
#7	chronic kidney insufficienc*[Text Word]	200
#8	chronic nephropath*[Text Word]	565
#9	"Risk Assessment"[Mesh]	194168
#10	"Early Diagnosis"[Mesh:NoExp]	18262
#11	"Early Medical Intervention"[Mesh]	1273
#12	"Health Promotion"[Mesh]	59581
#13	"Primary Prevention"[Mesh:NoExp]	15079
#14	screening[Text Word]	433232
#15	risk assessment[Text Word]	213552
#16	early diagnosis[Text Word]	71412
#17	disease early detection[Text Word]	16
#18	early medical intervention*[Text Word]	1398
#19	health promotion*[Text Word]	69447
#20	wellness program*[Text Word]	869
#21	health campaign*[Text Word]	1083
#22	primary prevention[Text Word]	26107
#23	"Workplace"[Mesh]	15286
#24	"Nurses, Community Health"[Mesh]	460
#25	"Hospitals, Community"[Mesh]	10709
#26	"Community Pharmacy Services"[Mesh]	3144
#27	"Community Medicine"[Mesh]	1919
#28	"Community Health Services"[Mesh]	256423
#29	"Community Health Nursing"[Mesh]	18845
#30	"Community Health Centers"[Mesh]	10795
#31	"Community Health Workers"[Mesh]	3583
#32	workplace[Text Word]	34686
#33	community[Text Word]	397345
#34	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8	37096
#35	#9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22	784351
#36	#23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33	600401
#37	#34 AND #35 AND #36	260

Scopus January, 2016

No	Query	Results
#1	INDEXTERMS ("Renal Insufficiency, Chronic")	8523
#2	INDEXTERMS ("chronic kidney disease")	29325
#3	TITLE-ABS-KEY (“chronic renal insufficienc*”)	5452
#4	TITLE-ABS-KEY (“chronic renal disease”*)	4230
#5	TITLE-ABS-KEY (“chronic kidney disease*”)	42341
#6	TITLE-ABS-KEY (“chronic kidney disorder*”)	20
#7	TITLE-ABS-KEY (“chronic kidney function”)	2129
#8	TITLE-ABS-KEY (“chronic kidney insufficienc*”)	175
#9	TITLE-ABS-KEY (“chronic nephropathy*”)	681
#10	INDEXTERMS ("Risk Assessment")	538457
#11	INDEXTERMS ("early diagnosis")	76728
#12	INDEXTERMS ("early medical intervention")	1146
#13	INDEXTERMS ("health promotion")	87493
#14	INDEXTERMS ("primary prevention")	32769
#15	INDEXTERMS ("screening")	505458
#16	TITLE-ABS-KEY ("Risk Assessment")	570986
#17	TITLE-ABS-KEY ("early diagnosis")	137481
#18	TITLE-ABS-KEY ("disease early detection")	344
#20	TITLE-ABS-KEY ("early medical intervention*")	1310
#21	TITLE-ABS-KEY ("health promotion*")	102881
#22	TITLE-ABS-KEY ("wellness program*")	1122
#23	TITLE-ABS-KEY ("health campaign*")	1518
#24	TITLE-ABS-KEY ("primary prevention*")	44205
#25	TITLE-ABS-KEY ("screening")	830060
#26	INDEXTERMS ("workplace")	32302
#27	INDEXTERMS ("nurses, community health")	524
#28	INDEXTERMS ("hospitals, community")	10714
#29	INDEXTERMS ("community pharmacy services")	3083
#30	INDEXTERMS ("community medicine")	3120
#31	INDEXTERMS ("community health services")	27560
#32	INDEXTERMS ("community health nursing")	21574
#33	INDEXTERMS ("community health centers")	6058
#34	INDEXTERMS ("community health workers")	1114
#35	TITLE-ABS-KEY (workplace)	84912
#36	TITLE-ABS-KEY (community)	1044850
#37	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9	53460
#38	#10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25	1596418
#39	#26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36	1124427
#40	#37 AND #38 AND #39	508
#41	#40 AND (LIMIT-TO (DOCTYPE, “ar”) OR LIMIT-TO (DOCTYPE, “cp”) OR LIMIT-TO (DOCTYPE, “ip”))	407

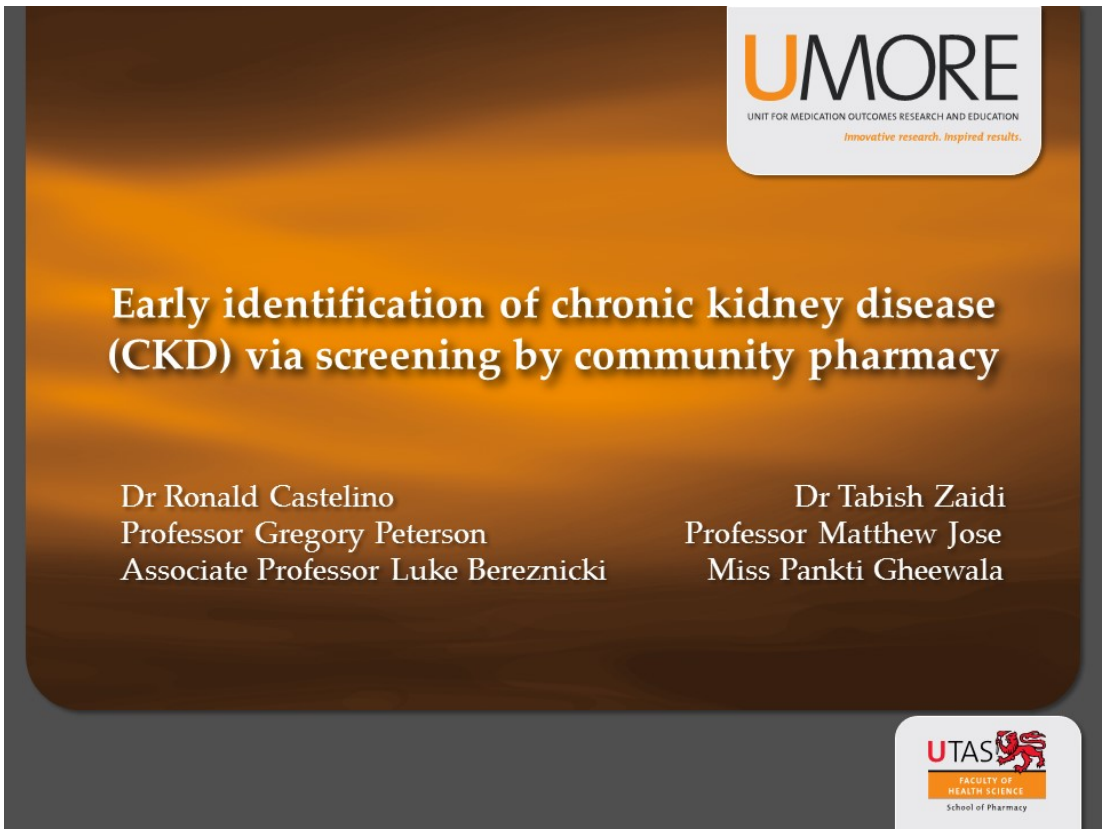
The Cochrane Library January, 2016

No	Query	Results
#1	[Renal Insufficiency, Chronic] MeSH:NoExp	441
#2	chronic renal insufficienc*:ti,ab,kw	997
#3	chronic renal disease*:ti,ab,kw	3805
#4	chronic kidney disease*:ti,ab,kw	4591
#5	chronic kidney disorder*: ti,ab,kw	370
#6	chronic kidney function:ti,ab,kw	2192
#7	chronic kidney insufficienc*:ti,ab,kw	2161
#8	chronic nephropath*:ti,ab,kw	925
#9	"Risk Assessment"[Mesh]	7949
#10	"Early Diagnosis"[Mesh:NoExp]	459
#11	"Early Medical Intervention"[Mesh]	102
#12	"Health Promotion"[Mesh]	4249
#13	"Primary Prevention"[Mesh:NoExp]	3635
#14	screening:ti,ab,kw	25045
#15	risk assessment:ti,ab,kw	26078
#16	early diagnosis:ti,ab,kw	6466
#17	early detection of disease*:ti,ab,kw	979
#18	early medical intervention*:ti,ab,kw	1964
#19	health promotion*:ti,ab,kw	6070
#20	wellness program*:ti,ab,kw	215
#21	health campaign*:ti,ab,kw	582
#22	primary prevention:ti,ab,kw	11035
#23	"Workplace"[Mesh]	534
#24	"Nurses, Community Health"[Mesh]	3
#25	"Hospitals, Community"[Mesh]	192
#26	"Community Pharmacy Services"[Mesh]	214
#27	"Community Medicine"[Mesh]	41
#28	"Community Health Services"[Mesh]	25206
#29	"Community Health Nursing"[Mesh]	380
#30	"Community Health Centers"[Mesh]	513
#31	"Community Health Workers"[Mesh]	242
#32	workplace:ti,ab,kw	1398
#33	community:ti,ab,kw	20486
#34	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8	7615
#35	#9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22	71906
#36	#23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33	42256
#37	#34 AND #35 AND #36	62
#38	#37 (Limit Trials)	43

Appendix 2 PROJECT II (A)

CHAPTER 2. A Web-based Training Program to Support Chronic Kidney Disease Screening by Community Pharmacists

Appendix 2.1 Pharmacists' online training module



Overview

Section 1: Introduction to CKD

Section 2: Renally cleared medications (RCMs)

Section 3: Why community pharmacy screening for chronic kidney disease (CKD) ?

Section 4: Qkidney® Risk Assessment Screening Protocol

Learning Objectives

Upon completion of this training, pharmacists should be able to:

1. Demonstrate appropriate skills and knowledge with respect to chronic kidney disease and renally cleared medications.
2. Effectively pre-screen from the general population, people who possess risk factors for developing chronic kidney disease.
3. Demonstrate suitable skills and knowledge for the performance of the "Qkidney® risk assessment" screening protocol.
3. Provide excellent pharmacological and non-pharmacological management counseling to participants identified at high risk of developing chronic kidney disease.
4. Critically review the medication regimen of high risk patients for prescribing of renally cleared medications.
5. Establish an organisational structure supportive of achieving the specific goals for effective performance of the screening study.

Section 1

Chronic kidney disease (CKD)

(1) Definition

(2) Functions of kidneys

(3) Possible complications of CKD

(4) Signs and Symptoms

(5) Risk factors for CKD

(6) Epidemiology

(7) Kidney function measures

(8) Prognosis

Chronic Kidney Disease

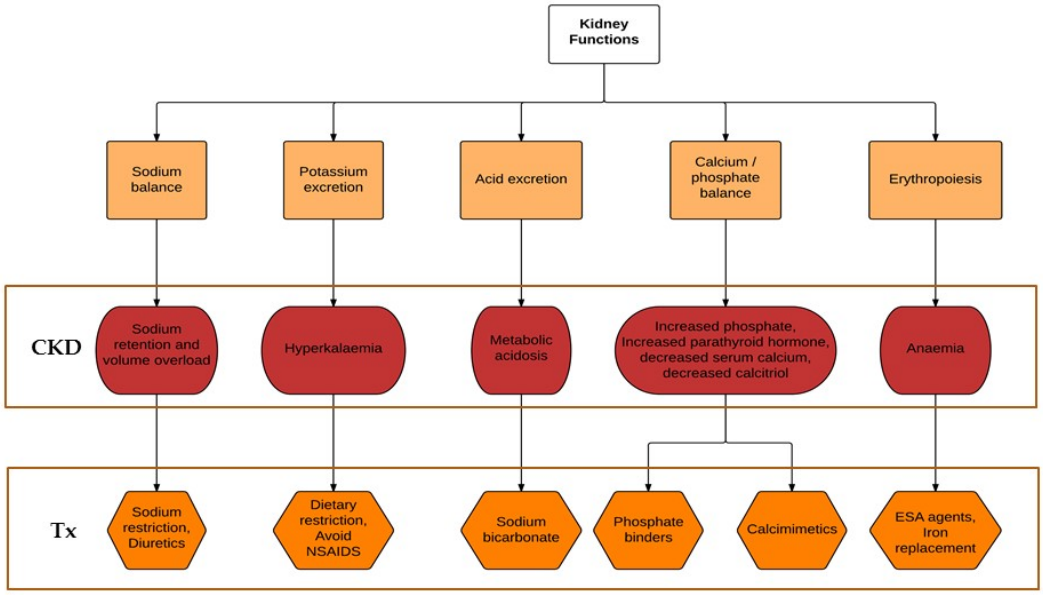
Chronic Kidney Disease (CKD) is defined as abnormalities in kidney structure or function present for 3 months or more.

- Structural abnormalities
  - Albuminuria (> 30mg/day)
  - Haematuria
  - Electrolyte abnormalities
- Functional abnormalities
  - Decrease in the glomerular filtration rate

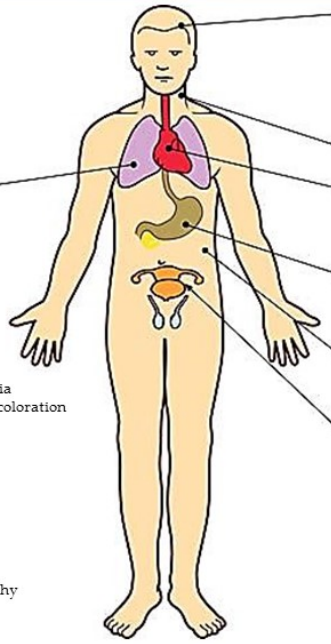
Functions of Kidneys

- ✓ Filtration of waste products
- ✓ Controls fluid volume
- ✓ Regulation of Na, K, PO4
- ✓ Regulation of acid–base
- ✓ Produces Renin (Regulates blood volume and blood pressure)
- ✓ Produces calcitriol (promotes formation of strong bones)
- ✓ Produces Erythropoietin (Stimulates the bone marrow to produce red blood cells)

Possible complications



Signs and Symptoms



Anaemia
Lethargy
Pallor

Haematological
Anaemia
Bruising

Respiratory
Dyspnoea
Tachypnoea

Skin
Pruritus
Scratch marks
Pigmentation
Purpura

Nail changes
Proximal leukonychia
Distal brownish discoloration

Flapping tremor

Musculoskeletal
Muscle weakness
Bone pain
Restless legs

Periphery
Peripheral neuropathy
Oedema

CNS
Weakness
Drowsiness

Severe uraemia
Confusion
Twitching
Fits
Coma

Hyperparathyroidism (secondary)

Cardiovascular
Heart failure
Hypertension
Pericarditis

Gastrointestinal tract
Anorexia, nausea
Vomiting
Hiccoughs
Diarrhoea

Renal
Polyuria
Nocturia

Genital
Erectile impotence
Infertility
Amenorrhoea

Haematuria
Proteinuria

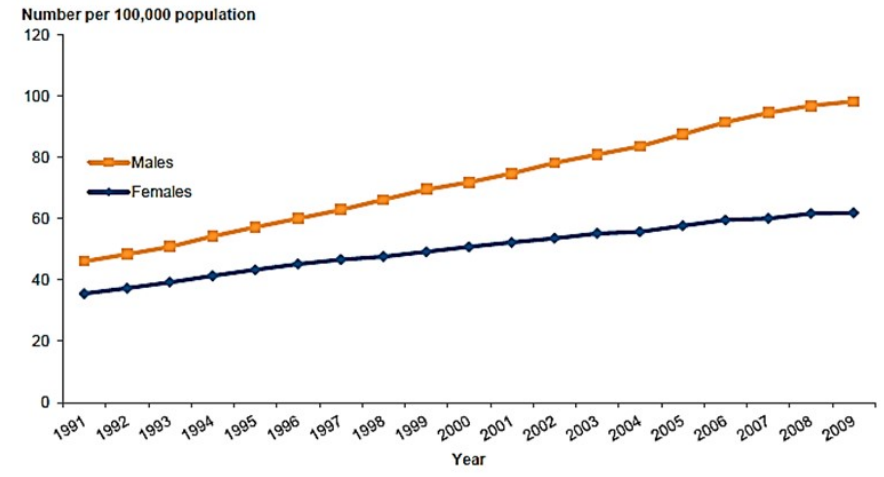
Risk Factors for CKD

- ✓ Age
- ✓ Diabetes
- ✓ High blood pressure ***(both cause and consequence of CKD)***
- ✓ Heart disease
- ✓ Family history of kidney disease
- ✓ Obese
- ✓ Smoker

Epidemiology: Incidence

- CKD is a **progressive** disease, the incidence of which increases with the increase in age.
- In Australia about 1.7 million people (1 in 10) aged 18 years and above have clinical evidence of CKD *(1)*.
- Less than 10 % of the people with CKD are aware that they have this condition *(1)*.
- Patients with undiagnosed CKD will progress to end-stage kidney disease (ESKD), who will need regular dialysis or transplantation to survive. These therapies are well-known as **renal replacement therapy (RRT).**
- Australia has seen an increase of **80 %** in a period of 10 years in the number of new patients who commenced RRT *(2)*.
- The mean age of patients commencing RRT in Australia in 2011 was 60 years and the median age was 62.3 years *(3)*.

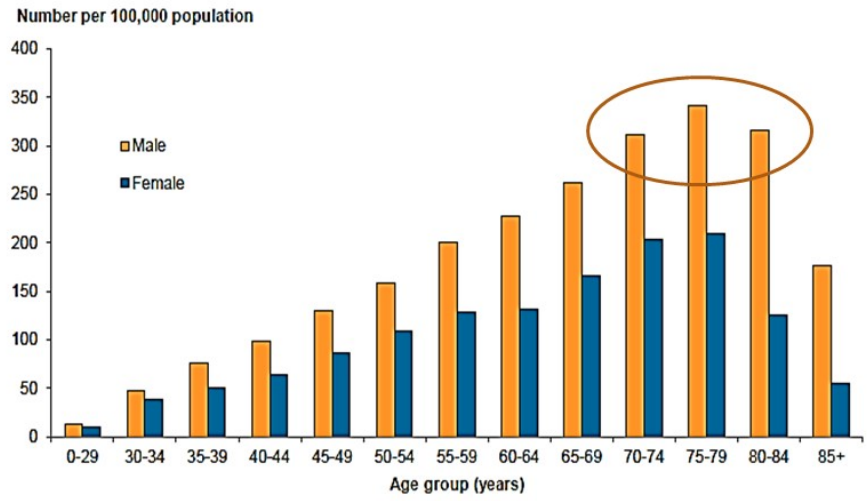
Overview of treatment trends for CKD over time period 1991-2009



Note: Directly age-standardised to the 2001 Australian population.

Source: AIHW analysis of ANZDATA Registry data.

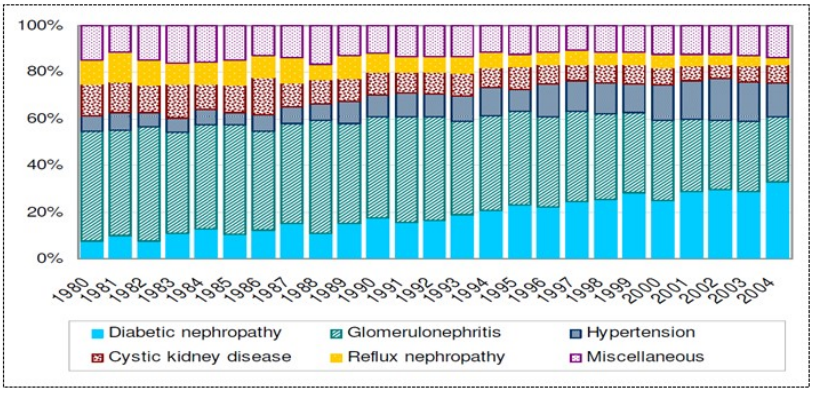
Overview of people receiving treatment by age for CKD



Source: AIHW analysis of ANZDATA Registry data.

Distribution of primary causes of CKD

- In Australia, the most common causes of CKD identified are:
  - Diabetes nephropathy (35 %) ***(leading cause)***
  - Glomerulonephritis (23 %)
  - Hypertension (15 %) *(4)*

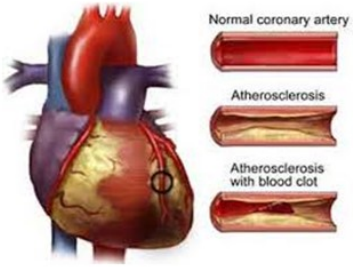


- A recent study reported that the "Prevalence of impaired kidney function in the general population is equivalent to that of diabetes mellitus" *(5)*.

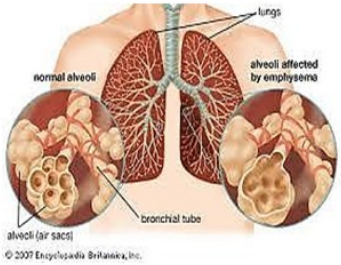
Epidemiology: Aetiology

Obesity

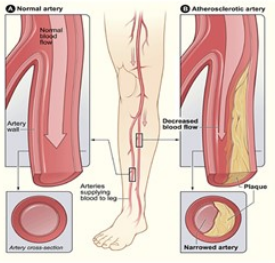
Smoking



Coronary artery disease



Chronic lung diseases



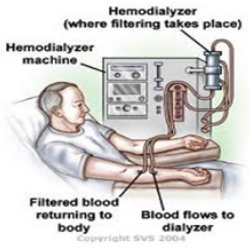
Peripheral vascular diseases

Epidemiology: Burden

- The prevalence of disability in those aged over 60 years with impaired kidney function was 65 % higher than in those aged over 60 years with normal kidney function *(7)*.
- 10% of all deaths are caused or contributed to, by kidney failure in Australia

Depression
Higher by 34% in patients with CKD

Dialysis
13% of all hospitalisations



Economic Burden
Cumulative cost estimated from 2009-2020 = $ 12 billion

Kidney Function measures

Blood Tests

Blood Urea Nitrogen (BUN)

- ✓ Urea nitrogen is the waste product that comes from the breakdown of proteins.
- ✓ A higher level indicates decline in kidney function.
- ✓ Other factors affect the BUN level and therefore cannot be used as a reliable indicator.

Serum Creatinine

- ✓ Creatinine is the waste product produced during muscle metabolism.
- ✓ It is freely filtered across glomerulus and is an endogenous marker used to determine the decline in kidney function.
- ✓ If the serum concentration of creatinine doubles, there is a 50 % decrease in the kidney function.
- ✓ Is affected by age, sex, race, muscle mass.

Kidney Function measures

Blood Tests

Glomerular Filtration Rate (GFR)

- ✓ Is the volume of fluid filtered from the glomerular capillaries into the Bowman's Capsule per unit time.
- ✓ Estimated GFR for an individual can be calculated from the serum creatinine using three different formulas: Cockroft-Gault (CG), modification of diet in renal disease (MDRD) and chronic kidney disease-epidemiology collaboration (CKD-EPI).

GFR (ml/min/1.73m^2)	Stage	Kidney function
≥ 90	1	Normal
60-89	2	Mildly decreased
45-59	3a	Mildly to moderately decreased
30-44	3b	Moderately to severely decreased
15-29	4	Severely decreased
<15	5	Kidney failure OR end-stage kidney disease (ESKD)

Kidney Function measures

Urine Tests

Urinalysis

- ✓ Proteinuria or microalbuminuria can be detected using a 24 hour urine collection method or urine dipstick test.
- ✓ Patients with high blood pressures and proteinuria >1 g/day have a significantly greater risk for progression of CKD.

Creatinine Clearance Rate

- ✓ is the volume of blood plasma that is cleared of creatinine per unit time.
- ✓ 24-hour urine collection method uses timed urine collection together with serum creatinine for measurement of urinary creatinine clearance (CrCl).
- ✓ However, this method is highly cumbersome, susceptible to error, difficult or impractical to obtain in the elderly and is not recommended routinely to estimate the level of kidney function

Prognosis of CKD

- Is dependent on the following factors:
  - Cause of kidney disease
  - GFR at the time of diagnosis
  - Degree of proteinuria (albuminuria)
  - Presence of other co-morbid conditions
- Bottom line is once the glomerulus is damaged, it tends to get worse over time (progressive disease)

Section 2

Renally Cleared Medications

(1) Pharmacokinetic changes in CKD

(2) Drugs that may accumulate and require renal function monitoring

(3) Drugs associated with renal function decline or nephrotoxicity

(4) Adverse drug events (ADE)

Pharmacokinetic changes in CKD

Altered pharmacokinetic parameters: absorption, distribution, metabolism and elimination (ADME)

Absorption

Reduced or slowed due to:

(1) Delayed gastric emptying *(Frusemide)*

(2) Reduced gastric acidity (*Ferrous sulphate poorly absorbed in alkaline environment)*

Distribution

Volume of distribution altered due to:

(1) Volume Overload *(dose adjustments necessary for hydrophilic drugs such as aminoglycosides)*

(2) Decreased protein binding *(Phenytoin: high plasma protein binding especially albumin)*

(3) Low serum albumin levels

(4) Alterations in tissue binding *(Digoxin: Increased sensitivity also possible due to electrolyte disturbances)*

Pharmacokinetic changes in CKD

Altered pharmacokinetic parameters: absorption, distribution, metabolism and elimination (ADME)

Metabolism *(carried out by the proximal convoluted tubule)*

Declines as the kidney function reduces.

Also, retention of uremic molecules may affect the hepatic enzymatic activity, thereby resulting in an increase or decrease in the hepatic metabolism rate.

Excretion

Decline in kidney function leads to accumulation of:

(1) Renally excreted drugs *(gabapentin)*
(2) Active drug metabolites *(codeine, morphine)*
(3) Drugs that are nephrotoxic *(bisphosphonates)*

Drugs that may accumulate and require renal function monitoring *(18)*

Neurological	Psychotropic	Cardiovascular	Musculoskeletal	Gastrointestinal
Baclofen	Acamprosate	ACEI[b]	Alendronate	H_2-antagonists[d]
Gabapentin	Amisulpride	A2RA[c]	Allopurinol	Metoclopramide
Galantamine	Alprazolam	Atenolol	Colchicine	
Levetiracetam	Bupropion	Bisoprolol	Methotrexate	
Memantine	Desvenlafaxine	Digoxin	Risedronate	
Methysergide	Duloxetine	Fenofibrate	Strontium Ranelate	
Paliperidone	Lithium	Spironolactone	Teriparatide	
Pramipexole	Reboxetine			
Pregabalin	Venlafaxine			
Topiramate				
Varenicline				

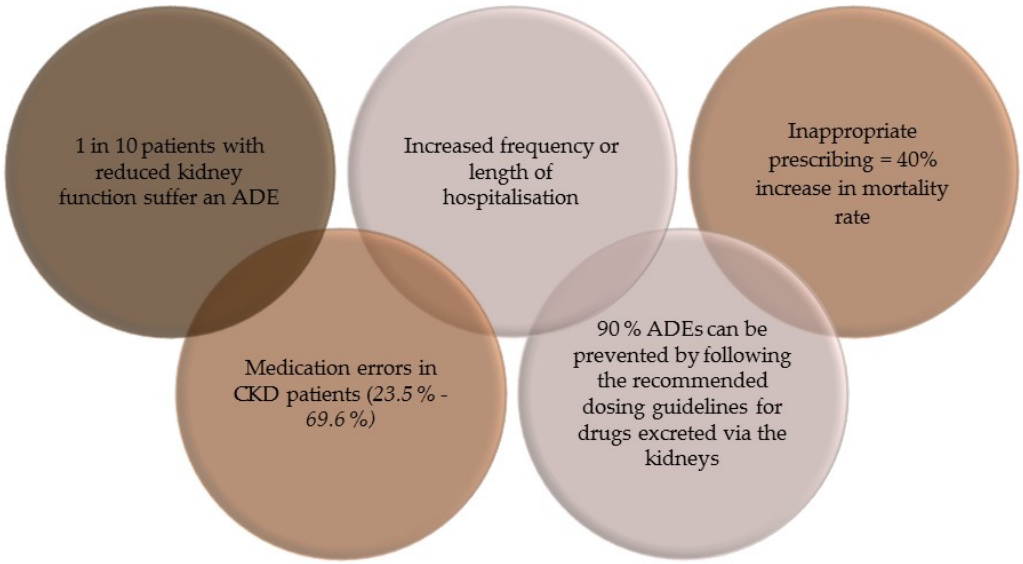
Analgesics	Genitourinary	Endocrine	Blood
Codeine	Solifenacin	Glibenclamide	Dabigatran
Hydromorphone	Sildenafil	Glimepride	Enoxaparin
Morphine	Tadalafil	Gliptins[e]	Rivaroxaban
Oxycodone	Tolterodine	Metformin	
Tramadol	Vardenafil		

[a] this list does not include antibiotic, antifungal or antiviral medicines, or those predominantly used in hospital settings
[b] Angiotensin Converting Enzymes inhibitors (ACEI): captopril, enalapril, lisinopril, perindopril, quinapril, ramipril
[c] Angiotensin 2 receptor antagonists (A2RA): candesartan, irbesartan, olmesartan, telmisartan
[d] Histamine 2 receptors antagonists (H_2-antagonists): ranitidine, famotidine
[e] Gliptins: saxagliptin, sitagliptin, vildagliptin

Drugs associated with renal function decline or nephrotoxicity (18)

Angiotensin Converting Enzymes Inhibitors (ACEI)
Angiotensin 2 Receptor Antagonists (A2RA)
Bisphosphonates
Cox-2 Inhibitors
Frusemide
H_2 antagonists
Non-Steroidal Anti-Inflammatory Drugs (NSAIDS)
Penicillamine
Proton Pump Inhibitors (PPI)

Adverse Drug events (ADE)



Section 3

Why community pharmacy screening for chronic kidney disease (CKD) ?

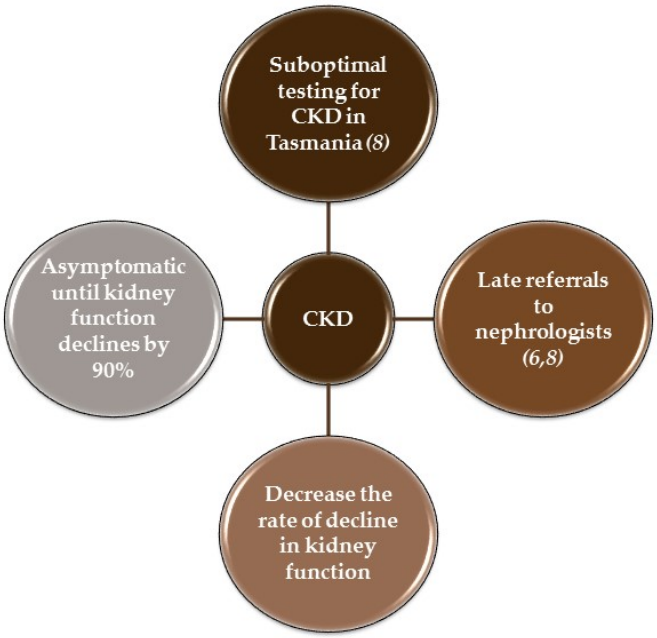
(1) Why early identification of CKD ?

(2) Community pharmacy screening services

(3) Why targeted screening?

(4) Qkidney® Scores

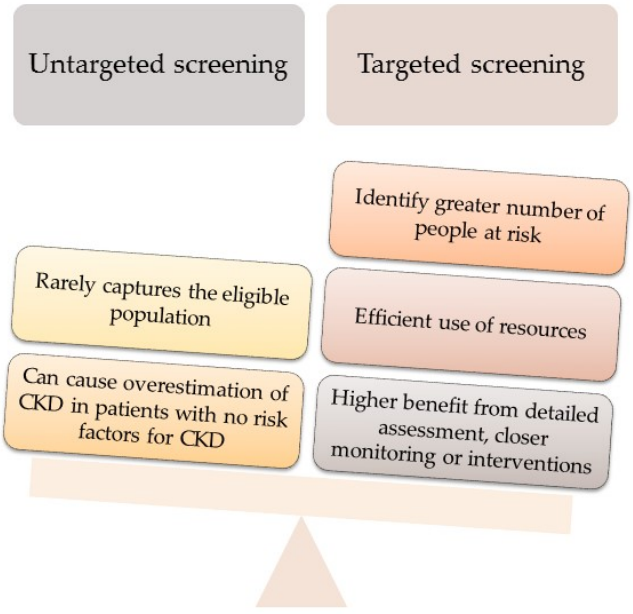
Why early identification of CKD ?



Community Pharmacy screening Services

- With respect to health screening, pharmacists are knowledgeable specialists. However, they are often seen as under-used health resource.
- Pharmacy represents a valuable opportunity to engage patient groups who are less likely to access GP based healthcare.
- Many OTC medications such as NSAIDS can cause nephrotoxicity
- Also, herbal medications contain heavy metal, phosphorous, potassium and many other substances which are harmful to kidneys
- Pharmacists provide counselling and play a major role in avoiding the ADE that can occur with the use of OTC and herbal medications

Why targeted screening?



Recommendations for individuals with CKD

Non-Pharmacological management
Refer SNAP guidelines
Exercise 30 minutes 5 times per week
Weight loss if BMI >25 kg/m^2
Smoking Cessation
Alcohol: 2 standard drinks per day for men and one standard drink per day for women
Hypertension: Low-sodium diet (<2g/day, <90mmol/day)

Vaccines
Influenza yearly
Pneumococcal vaccine if eGFR <30ml/min/1.73m^2, nephrotoxic syndrome, diabetes, or receiving immunosuppression. Single booster dose at year 5
Hepatitis B vaccine if eGFR <30ml/min/1.73m^2 and risk of progression of CKD

Pharmacological Management

Blood Pressure target (with proteinuria): 125/75 (without proteinuria): 130/85
Use ACEI/ARB drugs
HgbA1c target: <7 or 7.5
Adjust doses of drug according to kidney function *(by reducing the dose or lengthening the dosing interval)*
Seek pharmacist or medical advice before using over-the-counter (OTC) medicines or nutritional protein supplements
Herbal medicines are not recommended
Temporarily discontinue potentially nephrotoxic/renally excreted drugs if eGFR <60ml/min/1.73m^2 in patients who are acutely unwell or hypovolemic (e.g. metformin, diuretics, NSAIDS/COX II inhibitors, lithium, digoxin)
ASA for secondary prevention only
Avoid oral phosphate-containing bowel preparations in people with a GFR <60ml/min/1.73m^2 or in those known to be at risk of phosphate nephropathy

Qkidney® Scores

Huge morbidity and mortality associated with CKD → High rates of hospitalisation, death and economic burden in UK → Research to produce good 'risk prediction models'

"Qkidney Scores" developed and validated on 2.4 million population of England and Wales in 2012 → Useful tools to predict the 5-year risk of moderate-severe kidney disease and ESKD in the UK *(16,17)* → Recommended by Kidney Health Australia (KHA) for screening of people with risk factors of CKD

Aims and Objectives

Aim

To identify people at high risk of developing moderate-severe kidney disease over the next 5 years by using a screening protocol 'Qkidney® Risk Assessment' in community pharmacies.

Objectives

To screen eligible participants in community pharmacies

To promote the appropriate use of RCMs

To create awareness on CKD

Section 5

Qkidney® Risk Assessment Screening Protocol *(19)*

1) Recruitment of participants
2) Screening protocol
3) Renally cleared medications
4) Letter to the general practitioner

Recruitment of Participants

Study Population

Inclusion

- People aged between 50 and 74 years
- People with at least one of the following risk factors for CKD:
  - High blood pressure
  - Diabetes
  - Heart disease (heart failure/past heart attack) and/or have had a stroke
  - Obese (BMI ≥ 30 kg/m^2)
  - Smoker
  - Family history of CKD

Exclusion

- People who have been previously diagnosed with CKD
- Pregnant women
- People highly dependent on medical care

Recruitment

- Promotional materials such as posters, flyers etc. will be provided
- Pharmacists may also directly approach and invite eligible people for participation
- Eligible participants will be provided with an information sheet:
  - Detail explanation of the screening process
  - Sharing of the screening results with their GP
  - Consent for follow-up at 6 months after undergoing the screening protocol
  - Access to their laboratory results
  - An invitation to participate in the survey at the conclusion of the study
- Participants are allowed to discuss this with their family and friends before making a decision regarding participation
- Participants must sign the consent form before undergoing the screening study

Screening Protocol

1) Qkidney® Risk Assessment Data Form
2) Qkidney® Results Sheet
3) Qkidney® Risk Calculator
4) Qkidney® Understanding Your Results
5) Qkidney® Health Professional Advice

Qkidney® Risk Assessment Data Form

- Participants will be asked to fill out a data form which includes questions related to:
  - Demographics: name, age, gender, date of birth, address, contact number
  - General practitioner (GP) details: GP name, general practice name and address
  - Clinical information: smoking status, medical history, family history
  - Medication history: prescription drugs, over the counter drugs, complementary and herbal medications

Qkidney® Results Sheet

- ✓ Participant's height, weight and blood pressure will be measured and recorded in the results sheet.
- ✓ A copy will be provided to the participant.

Qkidney® Risk Calculator

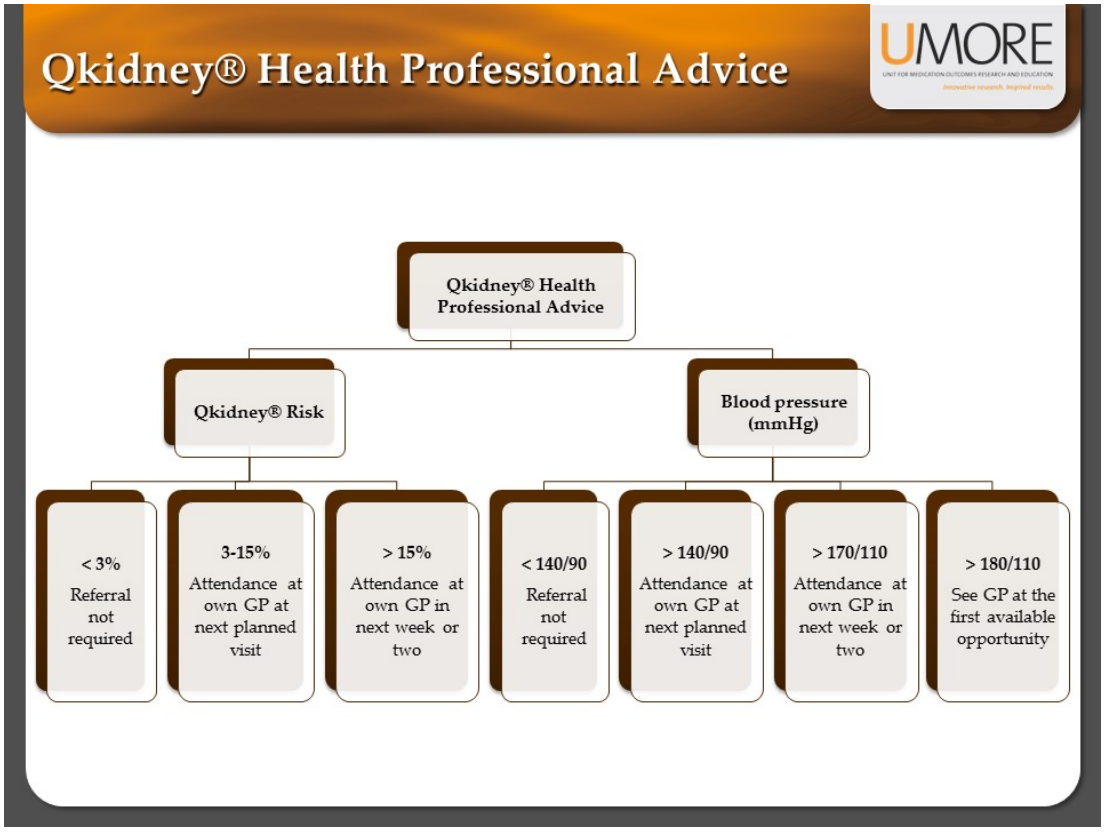
http://www.qkidney.org/

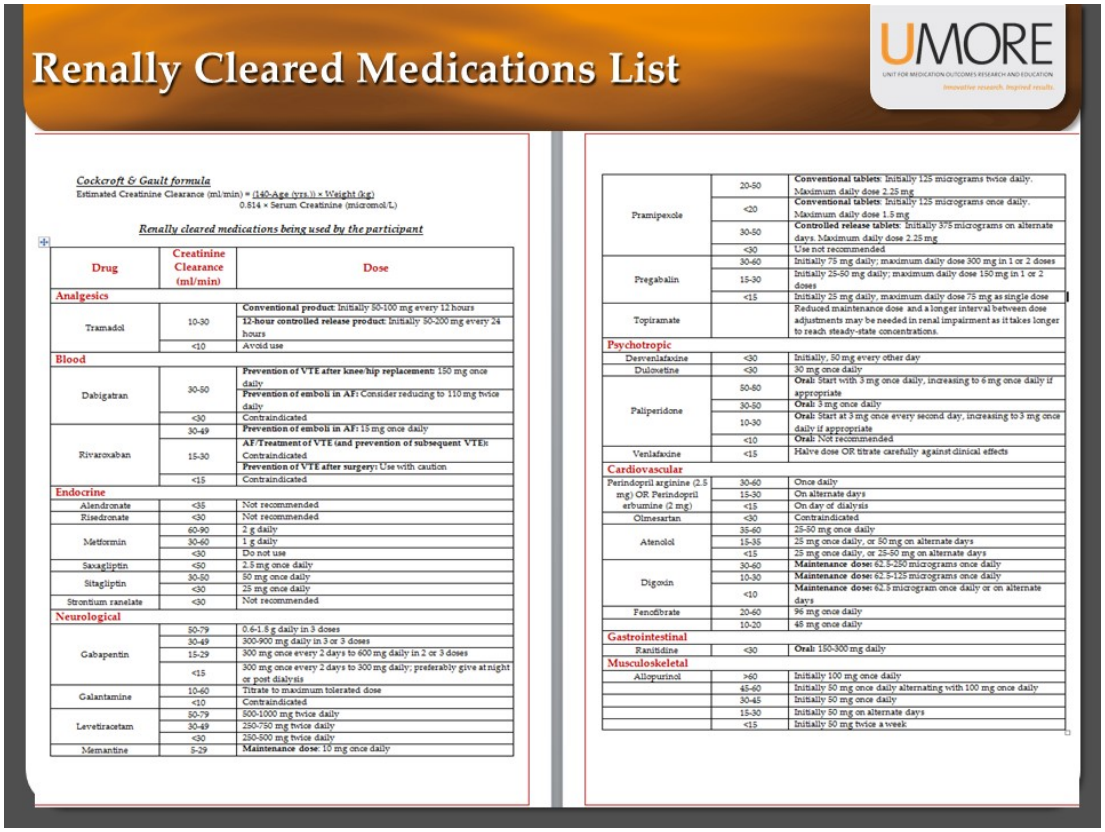
This calculates a person's risk of developing moderate-severe kidney disease over the next 5 years

The calculated risk will then be referred as 'Qkidney® Risk' and recorded in the 'Qkidney® Results Sheet'

Qkidney® Understanding Your Results

- ✓ Participants will be provided with:
  - ✓ Detailed explanation of their screening results
  - ✓ Patients with at least 3 % Qkidney® risk will be provided with a written educational material on kidney disease


Qkidney® Health Professional Advice
UMORE
UNIT FOR MEDICATION OUTCOMES RESEARCH AND EDUCATION
Innovative research. Inspired results.
Qkidney® Health Professional Advice
Qkidney® Risk
Blood pressure (mmHg)
< 3%
Referral not required
3-15%
Attendance at own GP at next planned visit
> 15%
Attendance at own GP in next week or two
< 140/90
Referral not required
> 140/90
Attendance at own GP at next planned visit
> 170/110
Attendance at own GP in next week or two
> 180/110
See GP at the first available opportunity


Renally Cleared Medications List
UMORE
UNIT FOR MEDICATION OUTCOMES RESEARCH AND EDUCATION
Innovative research. Inspired results.
Cockcroft & Gault formula
Estimated Creatinine Clearance (ml/min) = (140-Age (yrs.)) × Weight (kg)
0.814 × Serum Creatinine (micromol/L)
Renally cleared medications being used by the participant
Drug
Creatinine Clearance (ml/min)
Dose
Analgesics
Tramadol
10-30
Conventional product: Initially 50-100 mg every 12 hours
12-hour controlled release product: Initially 50-200 mg every 24 hours
<10
Avoid use
Blood
Dabigatran
30-50
Prevention of VTE after knee/hip replacement: 150 mg once daily
Prevention of emboli in AF: Consider reducing to 110 mg twice daily
<30
Contraindicated
Rivaroxaban
30-49
Prevention of emboli in AF: 15 mg once daily
15-30
AF/Treatment of VTE (and prevention of subsequent VTE): Contraindicated
Prevention of VTE after surgery: Use with caution
<15
Contraindicated
Endocrine
Alendronate
<35
Not recommended
Risedronate
<30
Not recommended
Metformin
60-90
2 g daily
30-60
1 g daily
<30
Do not use
Saxagliptin
<50
2.5 mg once daily
Sitagliptin
30-50
50 mg once daily
<30
25 mg once daily
Strontium ranelate
<30
Not recommended
Neurological
Gabapentin
50-79
0.6-1.8 g daily in 3 doses
30-49
300-900 mg daily in 3 or 3 doses
15-29
300 mg once every 2 days to 600 mg daily in 2 or 3 doses
<15
300 mg once every 2 days to 300 mg daily; preferably give at night or post dialysis
Galantamine
10-60
Titrate to maximum tolerated dose
<10
Contraindicated
Levetiracetam
50-79
500-1000 mg twice daily
30-49
250-750 mg twice daily
<30
250-500 mg twice daily
Memantine
5-29
Maintenance dose: 10 mg once daily
Pramipexole
20-50
Conventional tablets: Initially 125 micrograms twice daily. Maximum daily dose 2.25 mg
<20
Conventional tablets: Initially 125 micrograms once daily. Maximum daily dose 1.5 mg
30-50
Controlled release tablets: Initially 375 micrograms on alternate days. Maximum daily dose 2.25 mg
<30
Use not recommended
Pregabalin
30-60
Initially 75 mg daily; maximum daily dose 300 mg in 1 or 2 doses
15-30
Initially 25-50 mg daily; maximum daily dose 150 mg in 1 or 2 doses
<15
Initially 25 mg daily, maximum daily dose 75 mg as single dose
Topiramate
Reduced maintenance dose and a longer interval between dose adjustments may be needed in renal impairment as it takes longer to reach steady-state concentrations.
Psychotropic
Desvenlafaxine
<30
Initially, 50 mg every other day
Duloxetine
<30
30 mg once daily
Paliperidone
50-80
Oral: Start with 3 mg once daily, increasing to 6 mg once daily if appropriate
30-50
Oral: 3 mg once daily
10-30
Oral: Start at 3 mg once every second day, increasing to 3 mg once daily if appropriate
<10
Oral: Not recommended
Venlafaxine
<15
Halve dose OR titrate carefully against clinical effects
Cardiovascular
Perindopril arginine (2.5 mg) OR Perindopril erbumine (2 mg)
30-60
Once daily
15-30
On alternate days
<15
On day of dialysis
Olmesartan
<30
Contraindicated
Atenolol
35-60
25-50 mg once daily
15-35
25 mg once daily, or 50 mg on alternate days
<15
25 mg once daily, or 25-50 mg on alternate days
Digoxin
30-60
Maintenance dose: 62.5-250 micrograms once daily
10-30
Maintenance dose: 62.5-125 micrograms once daily
<10
Maintenance dose: 62.5 microgram once daily or on alternate days
Fenofibrate
20-60
96 mg once daily
10-20
48 mg once daily
Gastrointestinal
Ranitidine
<30
Oral: 150-300 mg daily
Musculoskeletal
Allopurinol
>60
Initially 100 mg once daily
45-60
Initially 50 mg once daily alternating with 100 mg once daily
30-45
Initially 50 mg once daily
15-30
Initially 50 mg on alternate days
<15
Initially 50 mg twice a week

Outcome measures

Primary Outcome

Number of participants identified at a risk of developing CKD via the screening protocol compared with number of participants diagnosed with CKD by GP.

Secondary outcome

(1) Changes in the medication regimen of participants diagnosed with CKD.

(2) Participant, Pharmacist and GP survey results.

Case Study

Mr Tyrion stark comes into your pharmacy after observing the poster for the screening study.

His elder sister Cersei Tyrell was diagnosed with CKD 2 years back and his father Tywin died of a heart attack last year.

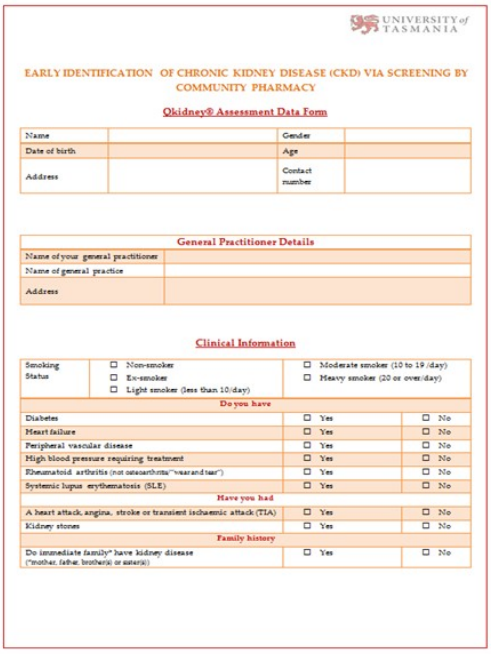
He says that he is eligible to participate and reveals the following details about him:

(1) 64 years
(2) Medical history of type 2 diabetes and hypertension
(3) Smoker (~ 10/day)

You decide that he is an eligible participant and then, give him an information sheet to read and a consent form to sign.

Mr. Tyrion comes back after 20 minutes with a signed consent form and asks when the study will be conducted?

Step 1: Assessment Data Form



EARLY IDENTIFICATION OF CHRONIC KIDNEY DISEASE (CKD) VIA SCREENING BY COMMUNITY PHARMACY

Qkidney® Assessment Data Form

Name		Gender	
Date of birth		Age	
Address		Contact number	

General Practitioner Details

Name of your general practitioner	
Name of general practice	
Address	

Clinical Information

Smoking Status	☐ Non-smoker ☐ Ex-smoker ☐ Light smoker (less than 10/day)	☐ Moderate smoker (10 to 19 /day) ☐ Heavy smoker (20 or over/day)

Do you have		
Diabetes	☐ Yes	☐ No
Heart failure	☐ Yes	☐ No
Peripheral vascular disease	☐ Yes	☐ No
High blood pressure requiring treatment	☐ Yes	☐ No
Rheumatoid arthritis (not osteoarthritis/"wear and tear")	☐ Yes	☐ No
Systemic lupus erythematosis (SLE)	☐ Yes	☐ No
Have you had		
A heart attack, angina, stroke or transient ischaemic attack (TIA)	☐ Yes	☐ No
Kidney stones	☐ Yes	☐ No
Family history		
Do immediate family* have kidney disease (*mother, father, brother(s) or sister(s))	☐ Yes	☐ No

Medication history

Prescription drugs		
Drug	Dose	Frequency

Over the counter (OTC) drugs		
Drug	Dose	Frequency

Do you use any	
Complementary Medications	
Herbal Medications	

For Pharmacist Use Only

Pharmacy ID		Participant ID	
Pharmacist ID		Today's date	

This study is being conducted by the Division of Pharmacy, School of Medicine at the University of Tasmania and funded by the Tasmanian Community Fund

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Reference

1. *Kidney Health Australia. QKIDNEY® RISK ASSESSMENT. 2014.* http://www.kidney.org.au/HealthProfessionals/QKidneyRiskAssessment/tabid/661/Default.aspx *Accessed 18/08/2014.*

Assessment Data Form Information

Clinical Information

Smoking status: Light smoker

Medical History:

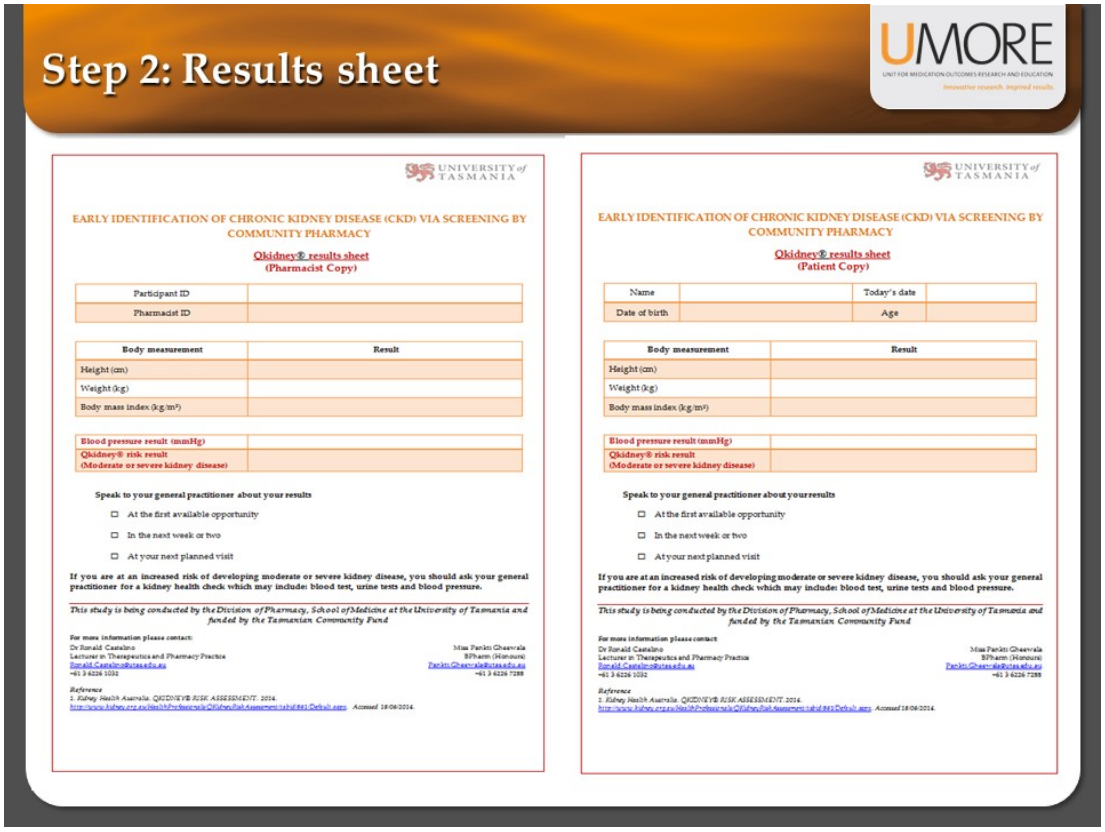
1. Type 2 Diabetes
2. Hypertension requiring treatment
3. Family history of kidney disease

His current medications are:

1. Metformin 2 g daily
2. Perindopril 4 mg daily
3. Aspirin OTC prn for hangover headaches

Mr Tyrion is 165 cm tall and weighs 85 kg.

His blood pressure when measured in the pharmacy was 150/90 mmHg.


Step 2: Results sheet
UMORE
UNIVERSITY of TASMANIA
EARLY IDENTIFICATION OF CHRONIC KIDNEY DISEASE (CKD) VIA SCREENING BY COMMUNITY PHARMACY
Qkidney® results sheet
(Pharmacist Copy)
Participant ID
Pharmacist ID
Body measurement
Result
Height (cm)
Weight (kg)
Body mass index (kg/m²)
Blood pressure result (mmHg)
Qkidney® risk result
(Moderate or severe kidney disease)
Speak to your general practitioner about your results
At the first available opportunity
In the next week or two
At your next planned visit
If you are at an increased risk of developing moderate or severe kidney disease, you should ask your general practitioner for a kidney health check which may include: blood test, urine tests and blood pressure.
This study is being conducted by the Division of Pharmacy, School of Medicine at the University of Tasmania and funded by the Tasmanian Community Fund
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Reference
1. Kidney Health Australia. QKIDNEY® RISK ASSESSMENT. 2014.
http://www.kidney.org.au/HealthProfessionals/QKidneyRiskAssessment/tabid/861/Default.aspx Accessed 18/06/2014.
EARLY IDENTIFICATION OF CHRONIC KIDNEY DISEASE (CKD) VIA SCREENING BY COMMUNITY PHARMACY
Qkidney® results sheet
(Patient Copy)
Name
Today's date
Date of birth
Age
Body measurement
Result
Height (cm)
Weight (kg)
Body mass index (kg/m²)
Blood pressure result (mmHg)
Qkidney® risk result
(Moderate or severe kidney disease)
Speak to your general practitioner about your results
At the first available opportunity
In the next week or two
At your next planned visit
If you are at an increased risk of developing moderate or severe kidney disease, you should ask your general practitioner for a kidney health check which may include: blood test, urine tests and blood pressure.
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Reference
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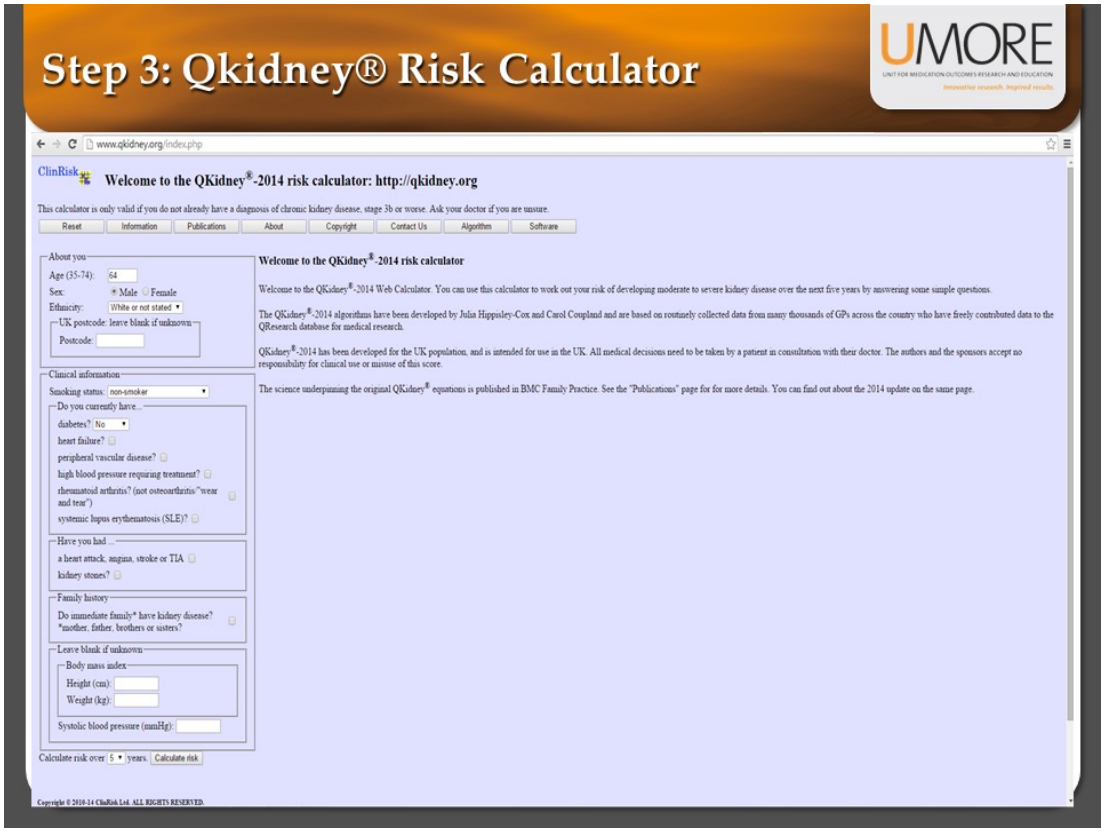
Step 3: Qkidney® Risk Calculator
UMORE
www.qkidney.org/index.php
ClinRisk
Welcome to the QKidney®-2014 risk calculator: http://qkidney.org
This calculator is only valid if you do not already have a diagnosis of chronic kidney disease, stage 3b or worse. Ask your doctor if you are unsure.
Reset
Information
Publications
About
Copyright
Contact Us
Algorithm
Software
About you
Age (35-74):
Sex:
Male
Female
Ethnicity:
White or not stated
UK postcode: leave blank if unknown
Postcode:
Clinical information
Smoking status:
non-smoker
Do you currently have...
diabetes?
No
heart failure?
peripheral vascular disease?
high blood pressure requiring treatment?
rheumatoid arthritis? (not osteoarthritis "wear and tear")
systemic lupus erythematosis (SLE)?
Have you had ...
a heart attack, angina, stroke or TIA
kidney stones?
Family history
Do immediate family* have kidney disease?
*mother, father, brothers or sisters?
Leave blank if unknown
Body mass index
Height (cm):
Weight (kg):
Systolic blood pressure (mmHg):
Calculate risk over:
5
years:
Calculate risk
Welcome to the QKidney®-2014 risk calculator
Welcome to the QKidney®-2014 Web Calculator. You can use this calculator to work out your risk of developing moderate to severe kidney disease over the next five years by answering some simple questions.
The QKidney®-2014 algorithms have been developed by Julia Hippisley-Cox and Carol Coupland and are based on routinely collected data from many thousands of GPs across the country who have freely contributed data to the QResearch database for medical research.
QKidney®-2014 has been developed for the UK population, and is intended for use in the UK. All medical decisions need to be taken by a patient in consultation with their doctor. The authors and the sponsors accept no responsibility for clinical use or misuse of this score.
The science underpinning the original QKidney® equations is published in BMC Family Practice. See the "Publications" page for for more details. You can find out about the 2014 update on the same page.
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Case Study results

Qkidney® Risk Score: 36 %.

Body Mass Index: 31.22 kg/m² (Obese).

Explain the patient the significance of his screening results:

- ✓ Patient is at a 36 % risk of developing moderate-severe kidney disease over the next five years meaning that he has "4 in 10" chance of getting moderate-severe kidney disease over the next five years.
- ✓ Patient has risk factors for developing CKD such as high blood pressure, diabetes, obesity, smoking, family history of CKD.
- ✓ Give lifestyle advice.
- ✓ Provide the educational materials.

Qkidney® Health Professional Advice: Attendance at own GP in next week or two.

Step 4: Explanation of results and advice

EARLY IDENTIFICATION OF CHRONIC KIDNEY DISEASE (CKD) VIA SCREENING BY COMMUNITY PHARMACY

Qkidney® Health Professional Advice

The Qkidney® calculator is used to identify a person's risk of developing moderate-severe kidney disease over the next five years. Based on the Qkidney® risk and/or blood pressure results, a comprehensive follow up by a general practitioner (GP) may be required that includes: blood test (serum creatinine for eGFR), urine test (albumin: creatinine ratio) and blood pressure. The tables below outline recommendations for referral to a GP based on Qkidney® risk and/or blood pressure results. These recommendations are based on the best information available. They are not intended to indicate an exclusive course of action. Variations, taking individual circumstances into account, may be appropriate.

Qkidney® Risk Results

<3%	Referral not typically required
3-15%	Requiring attendance at own general practitioner at next planned visit
>15%	Requiring attendance at own general practitioner in next week or two

Blood Pressure Results

BP<140/90mmHg	Referral not typically required
BP>140/90mmHg	Requiring attendance at own general practitioner at next planned visit
BP>170/110mmHg	Requiring attendance at own general practitioner in next week or two
BP>180/110mmHg	See general practitioner at the first available opportunity

General points to remember

1. Participant should be aged between 50 and 74 years.
2. Participant should not have a previous diagnosis of CKD.
3. Participant should be advised on modifiable risk factors such as quit smoking, weight loss, physical activity, blood pressure control etc. as appropriate.

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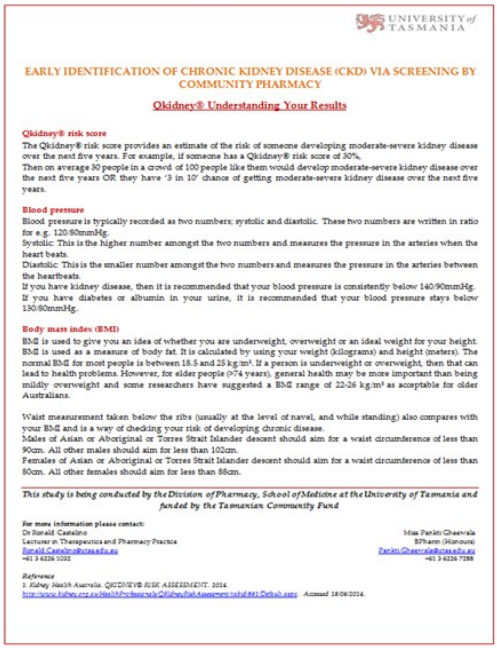
Reference
1. *Kidney Health Australia. QKIDNEY® RISK ASSESSMENT. 2014.*
http://qcsc.kidney.org.au/Health Professionals/QKidney/Risk Assessment tab/id 841/Default.aspx Accessed 18/08/2014.



EARLY IDENTIFICATION OF CHRONIC KIDNEY DISEASE (CKD) VIA SCREENING BY COMMUNITY PHARMACY

Qkidney® Understanding Your Results

Qkidney® risk score
The Qkidney® risk score provides an estimate of the risk of someone developing moderate-severe kidney disease over the next five years. For example, if someone has a Qkidney® risk score of 30%,
Then on average 30 people in a crowd of 100 people like them would develop moderate-severe kidney disease over the next five years OR they have '3 in 10' chance of getting moderate-severe kidney disease over the next five years.

Blood pressure
Blood pressure is typically recorded as two numbers; systolic and diastolic. These two numbers are written in ratio for e.g. 120/80mmHg.
Systolic: This is the higher number amongst the two numbers and measures the pressure in the arteries when the heart beats.
Diastolic: This is the smaller number amongst the two numbers and measures the pressure in the arteries between the heartbeats.
If you have kidney disease, then it is recommended that your blood pressure is consistently below 140/90mmHg.
If you have diabetes or albumin in your urine, it is recommended that your blood pressure stays below 130/80mmHg.

Body mass index (BMI)
BMI is used to give you an idea of whether you are underweight, overweight or an ideal weight for your height. BMI is used as a measure of body fat. It is calculated by using your weight (kilograms) and height (meters). The normal BMI for most people is between 18.5 and 25 kg/m². If a person is underweight or overweight, then that can lead to health problems. However, for elder people (>74 years), general health may be more important than being mildly overweight and some researchers have suggested a BMI range of 22-26 kg/m² as acceptable for older Australians.

Waist measurement taken below the ribs (usually at the level of navel, and while standing) also compares with your BMI and is a way of checking your risk of developing chronic disease.
Males of Asian or Aboriginal or Torres Strait Islander descent should aim for a waist circumference of less than 90cm. All other males should aim for less than 102cm.
Females of Asian or Aboriginal or Torres Strait Islander descent should aim for a waist circumference of less than 80cm. All other females should aim for less than 88cm.

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http://qcsc.kidney.org.au/Health Professionals/QKidney/Risk Assessment tab/id 841/Default.aspx Accessed 18/08/2014.

Step 5: Letter to the general practitioner

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EARLY IDENTIFICATION OF CHRONIC KIDNEY DISEASE (CKD) VIA SCREENING BY COMMUNITY PHARMACY

Letter to General Practitioner

Dear Doctor,

Re: 'Qkidney® Risk Assessment' screening study

Your patient ..... participated in the screening study 'Impact of Community Pharmacy Services on Screening for Chronic Kidney Disease' and has undergone the 'Qkidney® Risk Assessment' screening protocol. This study aims to identify people at high risk of developing moderate-severe kidney disease over the next five years and is being conducted by the Division of pharmacy, School of Medicine, at the University of Tasmania. The screening protocol uses 'Qkidney® Risk Calculator', a web based calculator for determining 5-year risk of developing moderate-severe kidney disease and can be accessed for free from the 'Kidney Health Australia' website.

The QKidney® algorithms were developed based on routinely collected data from many thousands of general practices across the United Kingdom and these algorithms have the potential to identify high risk patients who might benefit from more detailed assessment, closer monitoring or interventions to reduce their risk of kidney disease. The calculator requires height, weight and systolic blood pressure measures as well as responses to a few questions that relate to risk factors for chronic kidney disease (CKD). It is a great educational tool as people also learn what factors increase their risk of developing chronic kidney disease.

'Qkidney® Risk Assessment' screening study is a prospective cohort study and people with risk factors for CKD (such as hypertension, diabetes, heart disease, etc.) and who have not been previously diagnosed with CKD were screened to identify their 5-year risk of developing moderate-severe kidney disease.

Your patient ..... was identified as an eligible participant for this study and undertook the screening protocol on ../../.... The participant had a Qkidney® Risk of ..... for developing moderate-severe kidney disease over the next five years.

Please find attached with this letter participant's Qkidney® Assessment Data Form, Qkidney® Results Sheet, formula for calculating the creatinine clearance, renally cleared medications being used by the participant and dosing guidelines for these medications based on the creatinine clearance.

If you have any questions regarding the study, please contact Dr Ronald Castellino via e-mail or telephone (Ronald.Castellino@utas.edu.au or +61 3 6226 1032) or Miss Pankti Gheewala via e-mail on Pankti.Gheewala@utas.edu.au or +61 3 6226 7288)

Yours sincerely,

Dr Ronald Castellino

Step 6: Renally cleared medications

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Cockcroft & Gault formula

Estimated Creatinine Clearance (ml/min) = (140-Age (yrs)) × Weight (kg)
0.814 × Serum Creatinine (micromol/L)

Renally cleared medications being used by the participant

Drug	Creatinine Clearance (ml/min)	Dose
Analgesics		
Tramadol	10-30	**Conventional product**: Initially 50-100 mg every 12 hours
		12-hour controlled release product: Initially 50-200 mg every 24 hours
	<10	Avoid use
Blood		
Dabigatran	30-50	**Prevention of VTE after knee/hip replacement**: 150 mg once daily
		Prevention of emboli in AF: Consider reducing to 110 mg twice daily
	<30	Contraindicated
Rivaroxaban	30-49	**Prevention of emboli in AF:** 15 mg once daily
	15-30	**AF/Treatment of VTE (and prevention of subsequent VTE):** Contraindicated
		Prevention of VTE after surgery: Use with caution
	<15	Contraindicated
Endocrine		
Alendronate	<35	Not recommended
Risedronate	<30	Not recommended
Metformin	60-90	2 g daily
	30-60	1 g daily
	<30	Do not use
Saxagliptin	<50	2.5 mg once daily
Sitagliptin	30-50	50 mg once daily
	<30	25 mg once daily
Strontium ranelate	<30	Not recommended
Neurological		
Gabapentin	50-79	0.6-1.8 g daily in 3 doses
	30-49	300-900 mg daily in 3 or 3 doses
	15-29	300 mg once every 2 days to 600 mg daily in 2 or 3 doses
	<15	300 mg once every 2 days to 300 mg daily; preferably give at night or post dialysis
Galantamine	10-60	Titrate to maximum tolerated dose
	<10	Contraindicated
Levetiracetam	50-79	500-1000 mg twice daily
	30-49	250-750 mg twice daily
	<30	250-500 mg twice daily
Memantine	5-29	**Maintenance dose**: 10 mg once daily
Pramipexole	20-50	**Conventional tablets**: Initially 125 micrograms twice daily. Maximum daily dose 2.25 mg
	<20	**Conventional tablets**: Initially 125 micrograms once daily. Maximum daily dose 1.5 mg
	30-50	**Controlled release tablets**: Initially 375 micrograms on alternate days. Maximum daily dose 2.25 mg
	<30	Use not recommended
Pregabalin	30-60	Initially 75 mg daily; maximum daily dose 300 mg in 1 or 2 doses
	15-30	Initially 25-50 mg daily; maximum daily dose 150 mg in 1 or 2 doses
	<15	Initially 25 mg daily, maximum daily dose 75 mg as single dose
Topiramate		Reduced maintenance dose and a longer interval between dose adjustments may be needed in renal impairment as it takes longer to reach steady-state concentrations.
Psychotropic		
Desvenlafaxine	<30	Initially, 50 mg every other day
Duloxetine	<30	30 mg once daily
Paliperidone	50-80	**Oral:** Start with 3 mg once daily, increasing to 6 mg once daily if appropriate
	30-50	**Oral:** 3 mg once daily
	10-30	**Oral:** Start at 3 mg once every second day, increasing to 3 mg once daily if appropriate
	<10	**Oral:** Not recommended
Venlafaxine	<15	Halve dose OR titrate carefully against clinical effects
Cardiovascular		
Perindopril arginine (2.5 mg) OR Perindopril erbumine (2 mg)	30-60	Once daily
	15-30	On alternate days
	<15	On day of dialysis
Olmesartan	<30	Contraindicated
Atenolol	35-60	25-50 mg once daily
	15-35	25 mg once daily, or 50 mg on alternate days
	<15	25 mg once daily, or 25-50 mg on alternate days
Digoxin	30-60	**Maintenance dose:** 62.5-250 micrograms once daily
	10-30	**Maintenance dose:** 62.5-125 micrograms once daily
	<10	**Maintenance dose:** 62.5 microgram once daily or on alternate days
Fenofibrate	20-60	96 mg once daily
	10-20	48 mg once daily
Gastrointestinal		
Ranitidine	<30	**Oral:** 150-300 mg daily
Musculoskeletal		
Allopurinol	>60	Initially 100 mg once daily
	45-60	Initially 50 mg once daily alternating with 100 mg once daily
	30-45	Initially 50 mg once daily
	15-30	Initially 50 mg on alternate days
	<15	Initially 50 mg twice a week

Follow-up at 6 months

Participant follow–up at 6 months

Pathology providers will be contacted

Participant, Pharmacist and GP invited

Thank you for your time

Please proceed towards completing the Post-training survey

References

1. Kidney Health Australia. Fast facts on CKD in Australia. 2013. http://www.kidney.org.au/. Accessed 15/06/2014.
2. Australian Institute of Health and Welfare. Dialysis and kidney transplantation in Australia: 1991–2010. Cat. no. PHE 162. Canberra: AIHW. 2012 [5/06/2014]. Available from: http://www.aihw.gov.au/.
3. Grace B, Hurst K, McDonald S. Australia & New Zealand Dialysis & Transplant (ANZDATA) Registry 2012 Report: New Patients Commencing Treatment in 2011 2012 [5/06/2014]. Available from: http://www.anzdata.org.au/.
4. Cass A, Chadban S, Craig J, Howard H, McDonald S, Salkeld G, et al. The Economic Impact of End-Stage Kidney Disease in Australia 2006 [28/05/2014]. Available from: http://www.kidney.org.au/.
5. McCullough K, Sharma P, Ali T et al. Measuring the population burden of chronic kidney disease: a systematic literature review of the estimated prevalence of impaired kidney function. Nephrol Dial Transplant. 2012;27(5):1812-21. doi:10.1093/ndt/gfr547.
6. Polkinghorne K, Gulyani A, McDonald S, Hurst K. Australia & New Zealand Dialysis & Transplant (ANZDATA) Registry 2012 Report: Haemodialysis (including home dialysis) 2012 [28/05/2014]. Available from: http://www.anzdata.org.au/.
7. SK Tanamas, DJ Magliano, B Lynch, P Sethi, L Willenberg, KR Polkinghorne, et al. The Australian Diabetes, Obesity and Lifestyle Study 2012 [15/05/2014]. Available from: http://www.bakeridi.edu.au/Assets/Files/Baker%20IDI%20Ausdiab%20Report_interactive_FINAL.pdf.
8. Jose MD, Otahal P, Kirkland G, Blizzard L. Chronic kidney disease in Tasmania. Nephrology (Carlton, Vic). 2009;14(8):743-9.
9. Boudville N, Muthucumarana K, Inderjeeth C. Limited referral to nephrologists from a tertiary geriatric outpatient clinic despite a high prevalence of chronic kidney disease and anaemia. BMC geriatrics. 2012;12:43.

References

10. Cantu TG, Ellerbeck EF, Yun SW, Castine SD, Kornhauser DM. Drug prescribing for patients with changing renal function. American journal of hospital pharmacy. 1992;49(12):2944-8.
11. Hu KT, Matayoshi A, Stevenson FT. Calculation of the estimated creatinine clearance in avoiding drug dosing errors in the older patient. The American journal of the medical sciences. 2001;322(3):133-6.
12. Long CL, Raebel MA, Price DW, Magid DJ. Compliance with dosing guidelines in patients with chronic kidney disease. Ann Pharmacother. 2004;38(5):853-8.
13. Papaioannou A, Clarke JA, Campbell G, Bedard M. Assessment of adherence to renal dosing guidelines in long-term care facilities. Journal of the American Geriatrics Society. 2000;48(11):1470-3.
14. Yap C, Dunham D, Thompson J, Baker D. Medication dosing errors for patients with renal insufficiency in ambulatory care. Joint Commission journal on quality and patient safety / Joint Commission Resources. 2005;31(9):514-18. Collins G, Altman D. Predicting the risk of chronic kidney disease in the UK: an evaluation of QKidney(R) scores using a primary care database. Br J Gen Pract. 2012;62(597):e243-50.
15. Breton G, Froissart M, Janus N, Launay-Vacher V, Berr C, Tzourio C, et al. Inappropriate drug use and mortality in community-dwelling elderly with impaired kidney function--the Three-City population-based study. Nephrol Dial Transplant. 2011;26(9):2852-9.
16. Collins G, Altman D. Predicting the risk of chronic kidney disease in the UK: an evaluation of QKidney(R) scores using a primary care database. Br J Gen Pract. 2012;62(597):e243-50.
17. Hippisley-Cox J, Coupland C. Predicting the risk of chronic Kidney Disease in men and women in England and Wales: prospective derivation and external validation of the QKidney Scores. BMC Fam Pract. 2010;11:49.
18. Department of Veterans' Affairs. Veterans' MATES. Veterans' Medicines Advice and Therapeutics Education Services. Topic 30 - Renal impairment. Therapeutic Brief: Know your patient's renal function - an important prescribing consideration 2012 [18/06/2014]. Available from: https://www.veteransmates.net.au/VeteransMATES/VeteransMATESServlet?page=site&m=10020.
19. Kidney Health Australia. QKIDNEY® RISK ASSESSMENT 2014 [18/06/2014]. Available from: http://www.kidney.org.au/HealthProfessionals/QKidneyRiskAssessment/tabid/861/Default.aspx.

Appendix 2.2 Web-based questionnaire for evaluation of pharmacists' knowledge and skills at pre- and post-training

Pre- and post-training knowledge questions

Questions
(1) Which of the following is a possible complication of chronic kidney disease? a. Osteodystrophy b. Anaemia c. Metabolic acidosis d. Hyperkalaemia e. All of the above
(2) Which of the following is a good marker of renal function? a. Albumin b. Nitrogen c. Urea d. Serum creatinine e. None of the above
(3) Which of the following drugs is not excreted via the renal system? a. Baclofen b. Codeine c. Gabapentin d. Metformin e. Linagliptin
(4) The majority of patients with chronic kidney disease have following signs and symptoms a. Lethargy b. Anorexia c. Nocturia d. Pruritis e. None
(5) From the following people, who is at the highest risk of developing chronic kidney disease? a. 45 years, male, hypertension and smoker b. 70 years, female, diabetes and rheumatoid arthritis c. 65 years, male, obese, diabetes, high blood pressure, cardiovascular disease and smoker d. 50 years, female, family history of kidney disease and hypertension e. 62 years, male, high blood pressure, NSAIDS use and obese

Clinical Vignette

Mr James Moriarty is a 68 year old male with a medical history of hypertension and Type II diabetes. He smokes approximately 15 cigarettes/day, is overweight with a height of 170cm and weight of 90kg. He was diagnosed with depression 2 months ago and his regular medications are: Glibenclamide 10mg daily; Sitagliptin 50mg once daily; Lisinopril 5mg daily; Duloxetine 60mg once daily and; Ibuprofen prn. Mr Moriarty would like to undergo the screening service and reveals that he has had kidney stones before. His blood pressure when measured was 150/80 mmHg.
The five-year percentage risk of developing chronic kidney disease in this patient is around: a. 58 b. 30 c. 45 d. 18 e. None of the above

Appendix 2.3 Pharmacists' satisfaction survey

Survey Item	Agree strongly	Agree somewhat	Neither agree nor disagree	Disagree somewhat	Disagree strongly
Objectives of the training program were clearly defined	□	□	□	□	□
The content was organised and easy to follow	□	□	□	□	□
Content of the training program was relevant to me	□	□	□	□	□
Time allocated for the training program was sufficient	□	□	□	□	□
This training experience will be useful in my work	□	□	□	□	□
This training program further motivated me to participate in the study	□	□	□	□	□
Learning objectives of the training program were met	□	□	□	□	□
The lecturer has good knowledge with respect to the training topic	□	□	□	□	□
The lecturer communicated information clearly	□	□	□	□	□

Appendix 2.4 Letter of invitation

Letter of Invitation

Dear Sir/Madam,

The Division of Pharmacy, School of Medicine at the University of Tasmania is conducting a screening study funded by the Tasmanian Community Fund (TCF) for early detection of chronic kidney disease (CKD) via community pharmacy. This study aims to identify people at high risk of developing moderate-severe kidney disease over the next five years using the ***'Qkidney® Risk Assessment'*** protocol.

CKD is common amongst the Australian population with less than 1% of people aware that they have this condition. 1 in 3 Australians is at an increased risk of developing CKD and adult population are at an increased risk of CKD if they have diabetes, high blood pressure, heart problems, obese, smoker and have a family history of kidney disease. If detected early, CKD can be managed by appropriate lifestyle modifications (such as weight loss, diet changes, physical exercise, smoking cessation etc.) and by using drugs such as angiotensin converting enzyme (ACE) inhibitors/angiotensin 2 receptor blockers (A2RB). These early interventions can reduce the rate of progression of CKD and cardiovascular risk by as much as 50% and may also improve quality of life. This screening protocol will help identify people at high risk of developing moderate-severe kidney disease over the next five years so that they can be referred to their general practitioners for further diagnosis and management.

You have been invited to participate in the study as your community pharmacy has been recognised as one with strong representation of pharmacies within the rural Tasmania state. If your pharmacy chooses to participate in the study, then pharmacists are required to recruit approximately 40 participants and conduct the ***'Qkidney® Risk Assessment'*** screening protocol which will approximately take 15-20 minutes per participant. Each participating pharmacy will be reimbursed with $15 per participant for their time spent on conducting the screening protocol. We invite you to read the enclosed information sheet about the screening study.

We assure you that you are in no way obliged to agree to participate in this study. We will be happy to answer any questions you have about the study. You may contact Dr Ronald Castelino via e-mail or telephone (Ronald.Castelino@utas.edu.au or +61 3 6226 1032) or Miss Pankti Gheewala via e-mail or telephone on (Pankti.Gheewala@utas.edu.au or +61 3 6226 7288)

Yours Sincerely,

Dr Ronald L Castelino

Appendix 2.5 Pharmacist information sheet

Information Sheet

Invitation

You are invited to participate in a screening study being conducted to identify people with risk of developing moderate-severe kidney disease over the next five years.

The study is being conducted by

1. Dr Ronald Castelino, Pharmacy, School of Medicine, University of Tasmania
2. Professor Gregory Peterson, Pharmacy, School of Medicine, University of Tasmania
3. Associate Professor Luke Bereznicki, Pharmacy, School of Medicine, University of Tasmania
4. Dr Tabish Zaidi, Pharmacy, School of Medicine, University of Tasmania
5. Professor Matthew Jose, School of Medicine, University of Tasmania
6. Miss Pankti Gheewala, Pharmacy, School of Medicine, University of Tasmania

Before you decide whether or not you wish to participate in this study, it is important for you to understand why this study is being done and what it will involve.

Please take the time to read the following information carefully and discuss it with others if you wish.

1. 'What is the purpose of this study?'

The purpose is to investigate whether community pharmacy screening services can help identify people at risk of developing moderate-severe kidney disease over the next five years and to determine whether this service will help in improving the management and educating participants with kidney disease.

2. 'Why have I been invited to participate in this study?'

You have been invited to participate in the study because your community pharmacy was identified as one with strong representation of pharmacies within the rural Tasmania state.

3. 'What if I don't want to take part in this study, or if I want to withdraw later?'

Participation in this study is voluntary. It is completely up to you whether or not you participate. If you decide not to participate, this will not affect your relationship with the University of Tasmania. New information about the screening tool being studied may become available during the course of the study. You will be kept informed of any significant new findings that may affect your willingness to continue in the study. If you wish to withdraw from the study once it has started, you can do so at any time without having to give a reason.

4. 'What does this study involve?'

If your community pharmacy decides to participate in the study, then following is involved:

1. Pharmacists working at your community pharmacy will be provided with an information sheet to decide whether they would like to participate in the study. They will also be provided with a consent form which they are required to sign if they agree to participate in the study.
2. An online module to refresh knowledge on chronic kidney disease (CKD) and renally cleared medications will be arranged for participating community pharmacists. Pharmacists will also

be trained to conduct the screening protocol *'**Qkidney**® Risk Assessment'* after the completion of which they will be eligible to claim continuing professional development (CPD) points.

3. Screening protocol
   - The screening process will take approximately 15-20 minutes per participant. Screening will consists of the following:

   - ***Qkidney® risk assessment data form***
     This form will be used to collect information on demographics, medical history, family history, prescription medications and over the counter (OTC) drugs of eligible participants who are recruited in the study.

   - ***Qkidney® results sheet***
     Pharmacists are required to measure participant's height, weight and blood pressure, details of which will be recorded in the Qkidney® results sheet. Participants will also be provided with a copy of the results sheet for them to keep.

   - ***Qkidney® risk calculator***
     This calculator calculates a person's risk of developing moderate-severe kidney disease over the next five years. The Qkidney® algorithms are based on routinely collected data from many thousands of GPs (across United Kingdom) who have freely contributed data to the QResearch database for medical research.
     The 'Qkidney® risk assessment data form' is designed using the algorithms required by the 'Qkidney® risk calculator' as a reference and this data collected will be used to calculate respective participant's risk of moderate-severe kidney disease over the next five years using the Qkidney® web calculator. The result referred as the 'Qkidney® Risk', will then be recorded in the 'Qkidney® Results Sheet'.

   - ***Qkidney® Understanding Your Results***
     Participants will then be provided with 1) a detailed explanation of their screening results and 2) a written educational material on kidney disease by the pharmacist.

   - ***Qkidney® Health Professional Advice***
     Pharmacist will then advise the participants on appropriate action that needs to be taken based on their Qkidney® risk. This may or may not involve a comprehensive follow up by a GP that includes: blood test (serum creatinine for eGFR), urine test (albumin: creatinine ratio) and blood pressure measurement.

4. Pharmacists will be required to demonstrate competency in essential skills and knowledge relating to CKD, renally cleared medications and *'**Qkidney**® Risk Assessment'* protocol before commencing the study. Each pharmacy will be required to recruit approximately 40 eligible people in the study by mid-April 2015.

5. For participants identified with at least a 3% risk of developing moderate-severe CKD in the next 5 years, who are receiving high risk medications (considered problematic in CKD) and in whom a comprehensive follow-up with the GP is advised, pharmacists will be required to contact the GP via pre-printed 'Letter to general practitioners'.

These standardised pre-printed 'Letter to general practitioners' *(modifiable to include participant's name, Qkidney® Assessment Data Form, Qkidney® Results)* will be provided to the participating community pharmacies. All the supporting documents and promotional materials required for the performance of the study will be supplied by the research team.

5. 'How is this study being paid for?'

The study is being sponsored by the Tasmanian Community Fund (TCF) Board and supported by Division of Pharmacy, School of Medicine at the University of Tasmania. All of the money being paid by the sponsor to run the study will be deposited into an account managed by Division of Pharmacy, School of Medicine at the University of Tasmania. No money is paid directly to individual researchers.

6. 'Are there risks to me in taking part in this study?'

There are no known risks associated with this study.

7. 'Will I benefit from the study?'

This study will help to further increase knowledge and create awareness on CKD and may improve future intervention and management strategies that can be used in community pharmacies for identifying high risk patients. Also, participation in this study will allow the participating pharmacists to claim continuing professional development (CPD) points.

8. 'Will taking part in this study cost me anything, and will I be paid?

Participation in this study will not cost you anything and each participating pharmacy will be reimbursed with $15 per participant for the time spent on conducting the screening protocol. Additionally, you may be able to claim for MedsCheck and Diabetes MedsCheck pharmacy program incentives for eligible participants as per 5CPA guidelines.

9. 'What happens with the results?'

We plan to publish the results in peer-reviewed journals, presentation at conferences or other professional forums. In any publication, information will be provided in de-identified form. Results of the study will be provided to you, if you wish.

11. 'What will happen to the information when this study is over?'

All paper based items will be stored in a locked filling cabinet in the office of the chief investigator. Databases containing results will be stored on password protected computers at the School of Medicine. All the paper based data will be destroyed using a paper shredder and databases deleted 7 years after the conclusion of the study.

12. 'What should I do if I want to discuss this study further before I decide?'

If you would like more information or have any more questions at any stage, please do not hesitate to contact the researchers: Dr Ronald Castelino via e-mail or telephone (Ronald.Castelino@utas.edu.au or +61 3 6226 1032) or Miss Pankti Gheewala via e-mail or telephone on (Pankti.Gheewala@utas.edu.au or +61 3 6226 7288)

13. 'Who should I contact if I have concerns about the conduct of this study?'

This study has been approved by the Tasmanian Health and Medical Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study should contact the Executive Officer of the HREC (Tasmania) Network on (03) 6226 7479 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. You will need to quote [H0014258].

Thank you for taking the time to consider this study. This information sheet is for you to keep. If you wish to take part in it, please sign the consent form and post, e-mail or fax it to the address indicated on the form. Thank you for taking the time to consider this study.

Appendix 2.6 Pharmacy consent form

Consent Form

1. I have read and understood the information sheet for this screening study.

2. I acknowledge that the nature, purpose and contemplated effects of the screening study so far as it affects my community pharmacy, have been fully explained to my satisfaction by the research worker and my consent is given voluntarily.

3. I understand that my involvement means:
    a. Pharmacists working at my community pharmacy will be asked to participate in the study.
    b. Participating community pharmacists will be asked to undergo an online module organised to refresh knowledge on chronic kidney disease (CKD) and renally cleared medications.
    c. Pharmacists will be trained to conduct the screening protocol *'Qkidney® Risk Assessment'*.
    d. My community pharmacy is required to recruit approximately 40 participants for the purpose of this study by mid-April 2015.
    e. Pharmacists will be required to contact the GP via pre-printed 'Letter to general practitioners' for participants identified with at least 3% risk of developing moderate-severe CKD in the next 5 years, in whom a comprehensive follow-up with the GP is advised. These standardised pre-printed 'Letter to general practitioners' are modifiable to include participant's name, Qkidney® assessment data form, Qkidney® results.

4. I understand that this study will help to further increase knowledge and create awareness on chronic kidney disease and may improve future intervention and management strategies that can be used in community pharmacies for identifying high risk patients. Also, participating pharmacists will be able to claim continuing professional development (CPD) points.

5. I understand that the community pharmacy will be paid $ 15 per participant recruited and additionally the pharmacy will be able to claim for MedsCheck and Diabetes MedsCheck pharmacy program incentives for eligible participants as per 5CPA guidelines.

6. I understand that all the research data will be securely stored on the University of Tasmania premises for a period of 7 years, and will then be securely destroyed when no longer required.

7. I understand that research data gathered for the study will be published so that the participants and the participating pharmacy cannot be identified as participating in this study.

8. I am aware that if I decide to withdraw from the study at any time I can do so without any effect and I understand that this will not affect my relationship with the University of Tasmania.

9. I am aware that I am not giving up my legal rights by signing this consent form.

10. I understand that the study will be conducted in accordance with the latest versions of the *National Statement on Ethical Conduct in Human Research 2007* and applicable privacy laws.

Name of Community Pharmacy _____

Name of Pharmacy Owner _____

Signature of Pharmacy Owner _____

Contact Number _____

Fax Number _____

E-mail Address _____

Date _____

11. I have explained this study and the implications of participation in it to this community pharmacy owner and I believe that the consent is informed and that he/she understands the implications of participation.

Name of investigator **Ronald L Castelino**

Signature of investigator _____

Date **6/10/2014**

Please mail your completed Consent Form using the enclosed Reply Paid envelope

OR

E-mail your scanned copy to:
Pankti.Gheewala@utas.edu.au

OR

Fax your scanned copy to:
+61 3 6226 2870

Appendix 2.7 Pharmacist consent form

Pharmacist Consent Form

1. I have read and understood the information sheet for this screening study.

2. I acknowledge that the nature, purpose and contemplated effects of the screening study so far as it affects me, have been fully explained to my satisfaction by the research worker and my consent is given voluntarily.

3. I understand that my involvement means:
    a. That I will be asked to undergo an online training module to refresh my knowledge on chronic kidney disease (CKD) and renally cleared medications.
    b. I will be trained to conduct the screening protocol *'Qkidney® Risk Assessment'*.
    c. I will be required to demonstrate competency in essential skills and knowledge relating to *'Qkidney® Risk Assessment'* protocol before commencing the screening study and I will be eligible to claim 'Continuing Professional Development' points on completion of the training module.
    d. I will be required to recruit participants for the purpose of this study by mid-April 2015.
    e. I will be required to contact the GP via pre-printed 'Letter to general practitioners', for participants identified at high risk of developing moderate-severe CKD in the next 5 years, in whom a comprehensive follow-up with the GP is advised. These standardised pre-printed 'Letter to general practitioners' are modifiable to include participant's name, Qkidney® Assessment Data Form, Qkidney® Results.

4. Although I understand that the purpose of this screening study is to improve the quality of medical care, it has also been explained that my involvement may not be of any benefit to me.

5. I understand that the survey will be securely destroyed immediately on completion of the study and that any information I provide on the questionnaire will be identifiable only by my participating pharmacist ID, kept confidential, and viewed only by the researchers.

6. I understand that all the research data will be securely stored on the University of Tasmania premises for a period of 7 years, and will then be securely destroyed when no longer required.

7. I understand that research data gathered for the study will be published so that the participants and the participating pharmacy cannot be identified as participating in this study.

8. I am aware that if I decide to withdraw from the study at any time I can do so without any effect and I understand that this will not affect my relationship with the University of Tasmania

9. I am aware that I am not giving up my legal rights by signing this consent form.

10. I understand that the study will be conducted in accordance with the latest versions of the *National Statement on Ethical Conduct in Human Research 2007* and applicable privacy laws.

Name of Community Pharmacy	
Name of Pharmacist	
Pharmacist ID	
Signature of Pharmacist	
Date	

11. I have explained this study and the implications of participation in it to this community pharmacy owner and I believe that the consent is informed and that he/she understands the implications of participation.

Name of investigator	**Ronald L Castelino**
Signature of investigator	
Date	**6/10/2014**

Please mail your completed Consent Form using the enclosed Reply Paid envelope

OR

E-mail your scanned copy to:
Pankti.Gheewala@utas.edu.au

OR

Fax your scanned copy to:
+61 3 6226 2870

Appendix 3 PROJECT II (B)

CHAPTER 3. Evaluation of A Chronic Kidney Disease Risk Assessment Service in Community Pharmacies

Appendix 3.1 Poster

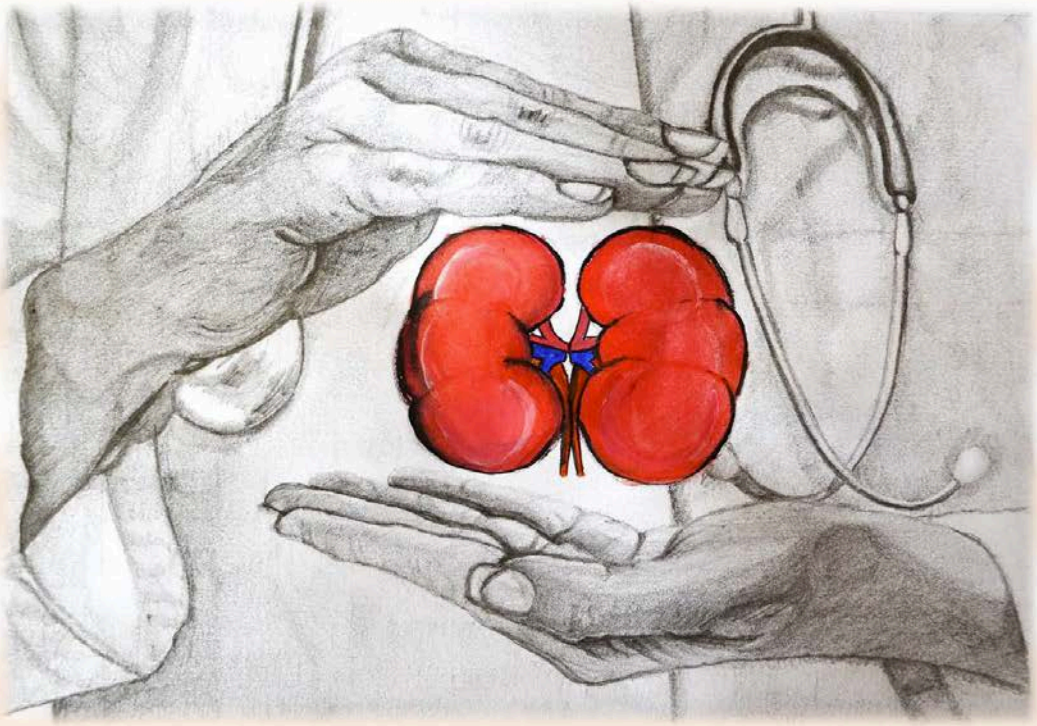
UMORE
UNIT FOR MEDICATION OUTCOMES RESEARCH AND EDUCATION
Innovative research. Inspired results.

Kidney Disease Screening Study

1 in 3 Australians are at an increased risk of developing kidney disease

Are you at risk?

Find out today!

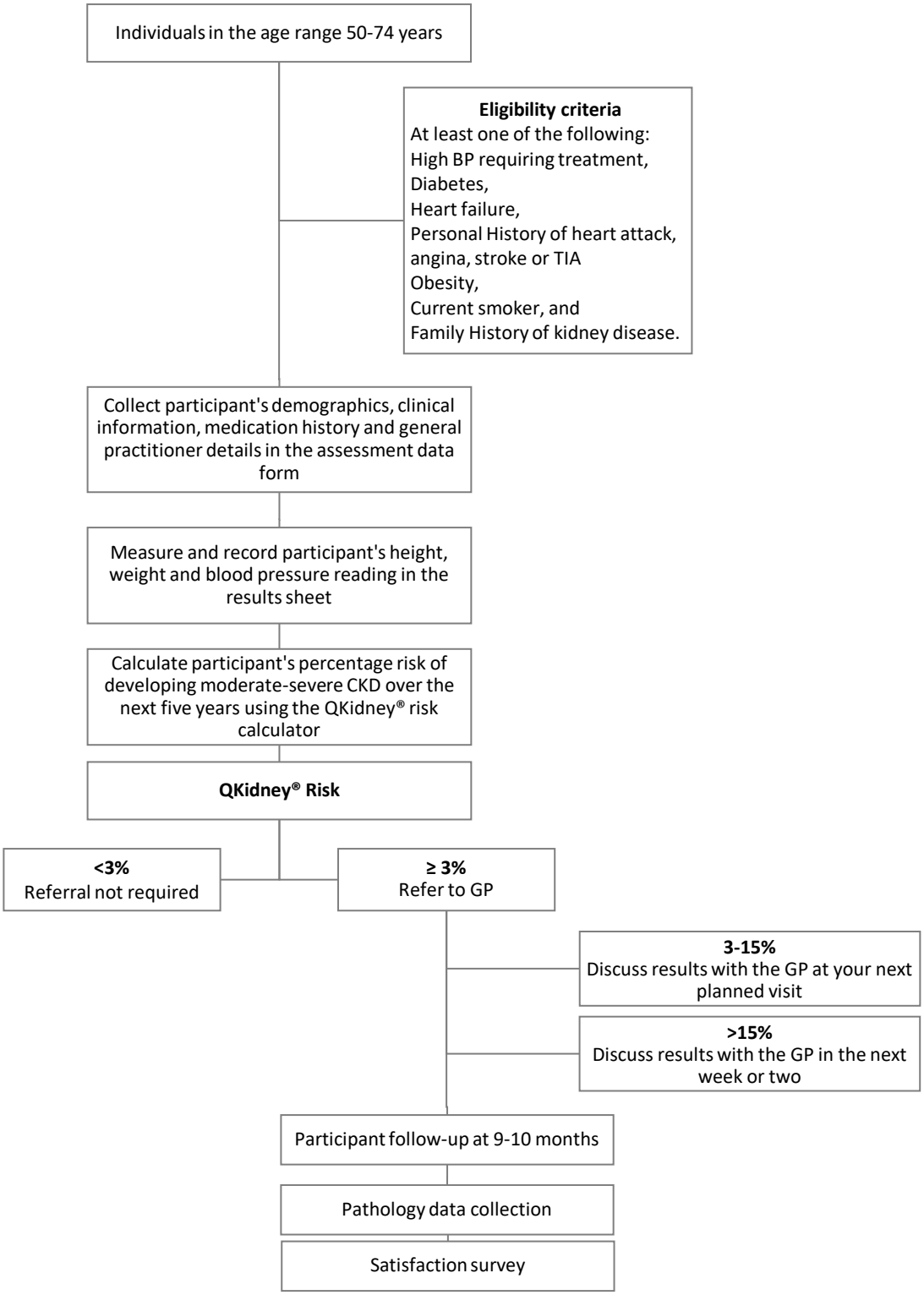


This study is being conducted by the Division of Pharmacy, School of Medicine at the University of Tasmania and funded by the Tasmanian Community Fund

For further information, please contact
Miss Pankti Gheewala BPharm (Honours)
E-mail: Pankti.Gheewala@utas.edu.au
Contact number: +61 3 6226 8535

UNIVERSITY of TASMANIA

Appendix 3.2 Chronic kidney disease risk assessment protocol



Appendix 3.3 Participant information sheet

Participant Information Sheet

Invitation

You are invited to participate in a screening study being conducted to identify people at risk of developing moderate-severe kidney disease over the next 5 years.

This study is being conducted by

1. Dr Ronald Castelino, Pharmacy, School of Medicine, University of Tasmania
2. Professor Gregory Peterson, Pharmacy, School of Medicine, University of Tasmania
3. Associate Professor Luke Bereznicki, Pharmacy, School of Medicine, University of Tasmania
4. Dr Tabish Zaidi, Pharmacy, School of Medicine, University of Tasmania
5. Professor Matthew Jose, School of Medicine, University of Tasmania
6. Miss Pankti Gheewala, Pharmacy, School of Medicine, University of Tasmania

Before you decide whether or not you wish to participate in this study, it is important for you to understand why the screening study is being done and what it will involve. Please take the time to read the following information carefully and discuss it with others if you wish.

1. 'What is the purpose of this study?'

The purpose is to investigate whether community pharmacy screening services can help identify people at risk of developing moderate-severe kidney disease over the next 5 years and to determine whether this service will help in improving the management and educating participants with kidney disease.

2. 'Why have I been invited to participate in this study?'

You are eligible to participate in this study because:

- You are between 50-74 years of age.
- Have at least one of the following risk factors for kidney disease:
  - High blood pressure
  - Diabetes
  - Heart disease (heart failure/past heart attack) and/or have had a stroke
  - Obese (BMI ≥ 30 kg/m^2)
  - Smoker
  - Family history of kidney disease
- You have not been previously diagnosed with kidney disease.
- You are not pregnant.
- You are not highly dependent on medical care.

3. 'What if I don't want to take part in this study, or if I want to withdraw later?'

Participation in this study is voluntary. It is completely up to you whether or not you participate. If you decide not to participate, it will not affect the treatment you receive now or in the future. Whatever your decision, it will not affect your relationship with the staff caring for you. New information about the screening tool being studied may become available during the course of the study. You will be kept informed of any significant new findings that may affect your willingness to continue in the

study. If you wish to withdraw from the study once it has started, you can do so at any time without having to give a reason. However, it may not be possible to withdraw your data from the study results if these have already had your identifying details removed.

4. 'What does this study involve?'

Before you participate in the study you have the opportunity to involve a member of your family or a friend present while the study is being explained to you. If you agree to participate in this study, you will be asked to sign the participant consent form.

This study will be conducted between January 2015 and April 2015.

If you agree to participate in this trial, you will then be asked to undergo the following procedures:

1. Initially, you will be asked to fill out a data form which includes questions related to
   a. Demographics (name, age, gender, date of birth, ethnicity, address, contact number)
   b. General practitioner (GP) details (GP name, general practice name and address)
   c. Clinical information (smoking status, medical history, family history)
   d. Medication history (prescription drugs, over the counter drugs, complimentary and herbal medications)
2. The next step involves measuring and recording your height, weight and blood pressure.
3. Using the above information, the screening calculator which is known as '*Qkidney® Risk Calculator'* will assess your risk of developing moderate-severe kidney disease over the next 5 years.
4. After the assessment, the pharmacist will explain you your screening results in detail. The pharmacist will also advise you on the appropriate action that needs to be taken based on your results. This may or may not involve a comprehensive follow up with your GP that requires a kidney health check. Your GP might ask you to undergo a blood test, urine test and also, measure your blood pressure to further investigate kidney disease.
5. The pharmacist will provide you with a 'Qkidney® risk results sheet' for your record and to discuss with your GP. Also, the pharmacist will provide educational material on kidney disease to you. The entire process mentioned above would approximately take 15-20 minutes.
6. If you have been identified with at least a 3% 5-year risk of moderate-severe kidney disease in the next 5 years, then the pharmacist will send a letter to your GP stating that you have undergone the screening study and give details on your screening results.
7. If your GP requires you to undergo laboratory tests such as urine test or blood test, then this information will also be collected from your pathology provider.
8. The research team will then approach you after a period of 6 months by telephone questionnaire to determine whether appropriate action was taken for management of your kidney disease, if you were identified with at least a 3% risk of developing moderate-severe kidney disease over the next 5 years.
9. You will also be invited to participate in a survey at the end of the study which will approximately take 5 minutes.

5. 'How is this study being paid for?'

The study is being sponsored by the Tasmanian Community Fund (TCF) Board and supported by Division of Pharmacy, School of Medicine at the University of Tasmania. All of the money being paid

by the sponsor to run the study will be deposited into an account managed by Division of Pharmacy, School of Medicine at the University of Tasmania. No money is paid directly to individual researchers.

6. 'Are there risks to me in taking part in this study?'
There are no known risks associated with this study.

7. 'Will I benefit from the study?'
This study aims to further medical knowledge and may improve future intervention and management strategies for people at high risk of developing kidney disease. However, it may not directly benefit you.

8. 'Will taking part in this study cost me anything, and will I be paid?
Participation in this study will not cost you anything.

9. 'How will my confidentiality be protected?'
Of the people treating you, only University researchers, community pharmacist and GP involved in your care will know whether or not you are participating in this study. Any identifiable information that is collected about you in connection with this study will remain confidential and will be disclosed only with your permission, or except as required by law. Only the researchers named above will have access to your details and results that will be held securely at the University of Tasmania.

10. 'What happens with the results?'
If you give us your permission by signing the consent form, we plan to publish the results in peer-reviewed journals, presentation at conferences or other professional forums.
In any publication, information will be provided in such a way that you cannot be identified. Results of the study will be provided to you, if you wish.

11. 'What should I do if I want to discuss this study further before I decide?'
When you have read this information, the community pharmacist will discuss it with you and any queries you may have. If you would like to know more at any stage, please do not hesitate to contact the researchers: Dr Ronald Castelino via e-mail or telephone (Ronald.Castelino@utas.edu.au or +61 3 6226 1032) or Miss Pankti Gheewala via e-mail on Pankti.Gheewala@utas.edu.au or +61 3 6226 7288)

15. 'Who should I contact if I have concerns about the conduct of this study?'
This study has been approved by the Tasmanian Health and Medical Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study you should contact the Executive Officer of the HREC (Tasmania) Network on (03) 6226 7479 or email human.ethics@utas.edu.au The Executive Officer is the person nominated to receive complaints from research participants. You will need to quote [H0014258].

This information sheet is for you to keep. If you wish to take part in it, please sign the consent form. If you decide not to participate in the study, kindly fill out 5 questions at the back of this form. Thank you for taking the time to consider this study.

Questionnaire for people who chose not to participate in the study

1. Age (years)
   - ☐ 50-59
   - ☐ 60-69
   - ☐ 70-74

2. Gender
   - ☐ Male
   - ☐ Female

3. I came to learn about the study via:
   - ☐ Poster
   - ☐ Pharmacist
   - ☐ Friends/Family
   - ☐ Other

   Please specify

   _____

4. Medical History:
   - ☐ High blood pressure
   - ☐ Diabetes
   - ☐ Heart disease
   - ☐ Other

   Please specify

   _____

Please rate your agreement with the statements provided below ranging from strongly disagree to strongly agree by ticking the appropriate boxes against the statement

	Strongly disagree	**Disagree**	**Neither disagree or agree**	**Agree**	**Strongly agree**
I found that the information sheet provided to me regarding the study was easy to read	**☐1**	**☐2**	**☐3**	**☐4**	**☐5**
I found that the information sheet provided to me regarding the study was easy to understand	**☐1**	**☐2**	**☐3**	**☐4**	**☐5**

Please specify below why you chose not to participate in the study

_____

Thank you for your time and assistance in completing this questionnaire

Appendix 3.4 Participant consent form

Participant Consent Form

1. I acknowledge that the nature, purpose and contemplated effects of the screening study so far as it affects me, have been fully explained to my satisfaction by the research worker and my consent is given voluntarily.

2. I have been given the opportunity to have a member of my family or friend present while the study was explained to me.

3. The details of the procedure proposed have also been explained to me, including the anticipated length of time it will take, the frequency with which the procedure will be performed, and an indication of any discomfort, which may be expected.

4. I understand that my involvement means:
   a. I will be asked to fill out a data form which includes questions related to
      i. Demographics (name, age, gender, date of birth, ethnicity, address, contact number)
      ii. General practitioner (GP) details (GP name, general practice name and address)
      iii. Clinical information (smoking status, medical history, family history)
      iv. Medication history (prescription drugs, over the counter drugs, complimentary and herbal medications)
   b. My height, weight and blood pressure will be measured and recorded.
   c. My risk of developing moderate-severe kidney disease over the next 5 years will be determined using the screening calculator known as *'Qkidney® Risk Calculator'* and recorded.
   d. My screening results will be explained to me in detail and I will be advised on appropriate action that needs to be taken based on my screening results.
   e. The entire process may take 15-20 minutes.
   f. That the appropriate action advised to me based on my screening results may or may not involve a comprehensive follow up with my general practitioner (GP) that requires a kidney health check.
   g. My GP might ask me to undergo a blood test, urine test and also, measure my blood pressure to further investigate kidney disease.
   h. If I was identified with at least a 3% risk of developing moderate-severe kidney disease over the next 5 years, then the pharmacist will send a letter to my GP stating that I have undergone the screening study and give details on my screening results.
   i. If I will be asked to undergo the laboratory tests such as urine test or blood test by my GP, then this information will be collected by the research team from my pathology provider.
   j. I will be approached by the researchers after a period of 6 months by telephone questionnaire to determine whether appropriate action was taken for management of kidney disease, if I was identified with at least a 3% 5-year risk of moderate-severe kidney disease.

k. I will be invited to participate in a survey by the researchers at the end of the study which will approximately take 5 minutes.

5. I understand that there are the following risks or possible discomfort:
   - Possible discomfort due to the underlying medical condition
   - Possible discomfort due to not clearly understanding the scientific reasons for the questions being asked.
   - Possible discomfort if I am diagnosed at a risk of developing moderate-severe kidney disease in the next 5 years.

6. Although I understand that the purpose of this screening study is to improve the quality of medical care, it has also been explained that my involvement may not be of any benefit to me.

7. I understand that the researchers will maintain my confidentiality and that any information I supply will be used only for the purposes of research. My data will only be identifiable by a unique participant ID.

8. I understand that the questionnaire and survey will be securely destroyed immediately on completion of the study and that any information I provide on the questionnaire will be identifiable only by my participant ID, kept confidential, and viewed only by the researchers.

9. I understand that all the research data will be securely stored on the University of Tasmania premises for a period of 7 years, and will then be securely destroyed when no longer required.

10. I understand that research data gathered from me for the study will be published provided that I cannot be identified as a participant.

11. I understand that my involvement in the project will not affect my relationship with my medical advisers in their management of my health. I am aware that if I decide to withdraw from the study at any time I can do so without any effect and I may also request to withdraw data that I may have supplied for the purpose of the study. My withdrawal will not affect my legal rights, my medical care or my relationship with the hospital or my GP.

12. I am aware that I am not giving up my legal rights by signing this consent form.

13. I understand that the study will be conducted in accordance with the latest versions of the *National Statement on Ethical Conduct in Human Research 2007* and applicable privacy laws.

Name of participant _____

Signature of participant _____

Date _____

14. I have explained this project and the implications of participation in it to this volunteer and I believe that the consent is informed and that he/she understands the implications of participation.

Name of investigator	**Ronald L Castelino**
Signature of investigator	
Date	**5/01/2015**

Appendix 3.5 Assessment data form

Qkidney® Assessment Data Form

Name		Gender	
Date of birth		Age	
Ethnicity	☐ White or not stated ☐ Indian ☐ Pakistani ☐ Bangladeshi ☐ Other Asian	☐ Black Caribbean ☐ Black African ☐ Chinese ☐ Other ethnic group	
Address		Contact number	

General Practitioner Details	
Name of your general practitioner	
Name of general practice	
Address	

Clinical Information

Smoking Status	☐ Non-smoker ☐ Ex-smoker ☐ Light smoker (less than 10/day)	☐ Moderate smoker (10 to 19 /day) ☐ Heavy smoker (20 or over/day)
Do you have		
Diabetes	☐ Yes ☐ Type 1 ☐ Type 2	☐ No
Heart failure	☐ Yes	☐ No
Peripheral vascular disease	☐ Yes	☐ No
High blood pressure requiring treatment	☐ Yes	☐ No
Rheumatoid arthritis (not osteoarthritis/"wear and tear")	☐ Yes	☐ No
Systemic lupus erythematosis (SLE)	☐ Yes	☐ No
Have you had		
A heart attack, angina, stroke or transient ischaemic attack (TIA)	☐ Yes	☐ No
Kidney stones	☐ Yes	☐ No
Family history		

Do immediate family* have kidney disease (*mother, father, brother(s) or sister(s))	☐ Yes	☐ No

Medication history

Prescription drugs		
Drug	Dose	Frequency
Over the counter (OTC) drugs		
Drug	Dose	Frequency
Do you use any		
Complementary Medications		
Herbal Medications		

For Pharmacist Use Only

Pharmacy ID		**Participant ID**	
Pharmacist ID		**Today's date**	

This study is being conducted by the Division of Pharmacy, School of Medicine at the University of Tasmania and funded by the Tasmanian Community Fund

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Reference
1. Kidney Health Australia. QKIDNEY® RISK ASSESSMENT. 2014. http://www.kidney.org.au/HealthProfessionals/QKidneyRiskAssessment/tabid/861/Default.aspx. Accessed 18/06/2014.

Appendix 3.6 Pharmacist results sheet

Qkidney® results sheet
(Pharmacist Copy)

Participant ID	
Pharmacist ID	

Body measurement	**Result**
Height (cm)	
Weight (kg)	
Body mass index (kg/m^2)	

Blood pressure result (mmHg)	
Qkidney® risk result (Moderate or severe kidney disease)	

Speak to your general practitioner about your results

☐ At the first available opportunity

☐ In the next week or two

☐ At your next planned visit

If you are at an increased risk of developing moderate or severe kidney disease, you should ask your general practitioner for a kidney health check which may include: blood test, urine tests and blood pressure.

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Reference
1. Kidney Health Australia. QKIDNEY® RISK ASSESSMENT. 2014. http://www.kidney.org.au/HealthProfessionals/QKidneyRiskAssessment/tabid/861/Default.aspx. Accessed 18/06/2014.

Appendix 3.7 Patient results sheet

Qkidney® results sheet
(Patient Copy)

Name		**Today's date**	
Date of birth		**Age**	

Body measurement	**Result**
Height (cm)	
Weight (kg)	
Body mass index (kg/m^2)	

Blood pressure result (mmHg)	
Qkidney® risk result (Moderate or severe kidney disease)	

Speak to your general practitioner about your results

☐ At the first available opportunity

☐ In the next week or two

☐ At your next planned visit

If you are at an increased risk of developing moderate or severe kidney disease, you should ask your general practitioner for a kidney health check which may include: blood test, urine tests and blood pressure.

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Appendix 3.8 Health professional advise for participants

Qkidney® Health Professional Advice

The Qkidney® calculator is used to identify a person's risk of developing moderate-severe kidney disease over the next 5 years. Based on the Qkidney® risk and/or blood pressure results, a comprehensive follow up by a general practitioner (GP) may be required that includes: blood test (serum creatinine for eGFR), urine test (albumin: creatinine ratio) and blood pressure. The tables below outline recommendations for referral to a GP based on Qkidney® risk and/or blood pressure results. These recommendations are based on the best information available. They are not intended to indicate an exclusive course of action. Variations, taking individual circumstances into account, may be appropriate.

Qkidney® Risk Results

<3%	Referral not typically required
3-15%	Requiring attendance at own general practitioner at next planned visit
>15%	Requiring attendance at own general practitioner in next week or two

Blood Pressure Results

BP<140/90mmHg	Referral not typically required
BP>140/90mmHg	Requiring attendance at own general practitioner at next planned visit
BP>170/110mmHg	Requiring attendance at own general practitioner in next week or two
BP>180/110mmHg	See general practitioner at the first available opportunity

General points to remember

1. Participant should be aged between 50 and 74 years.
2. Participant should not have a previous diagnosis of CKD.
3. Participant should be advised on modifiable risk factors such as quit smoking, weight loss, physical activity, blood pressure control etc. as appropriate.

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Appendix 3.9 Understanding your results

Qkidney® Understanding Your Results

Qkidney® risk score

The Qkidney® risk score provides an estimate of the risk of someone developing moderate-severe kidney disease over the next five years. For example, if someone has a Qkidney® risk score of 30%, then on average 30 people in a crowd of 100 people like them would develop moderate-severe kidney disease over the next 5 years OR they have '3 in 10' chance of getting moderate-severe kidney disease over the next 5 years.

Blood pressure

Blood pressure is typically recorded as two numbers; systolic and diastolic. These two numbers are written in ratio for e.g. 120/80mmHg.

Systolic: This is the higher number amongst the two numbers and measures the pressure in the arteries when the heart beats.

Diastolic: This is the smaller number amongst the two numbers and measures the pressure in the arteries between the heartbeats.

If you have kidney disease, then it is recommended that your blood pressure is consistently below 140/90mmHg.

If you have diabetes or albumin in your urine, it is recommended that your blood pressure stays below 130/80mmHg.

Body mass index (BMI)

BMI is used to give you an idea of whether you are underweight, overweight or an ideal weight for your height. BMI is used as a measure of body fat. It is calculated by using your weight (kilograms) and height (meters). The normal BMI for most people is between 18.5 and 25 kg/m^2. If a person is underweight or overweight, then that can lead to health problems. However, for elder people (>74 years), general health may be more important than being mildly overweight and some researchers have suggested a BMI range of 22-26 kg/m^2 as acceptable for older Australians. Waist measurement taken below the ribs (usually at the level of navel, and while standing) also compares with your BMI and is a way of checking your risk of developing chronic disease. Males of Asian or Aboriginal or Torres Strait Islander descent should aim for a waist circumference of less than 90cm. All other males should aim for less than 102cm. Females of Asian or Aboriginal or Torres Strait Islander descent should aim for a waist circumference of less than 80cm. All other females should aim for less than 88cm.

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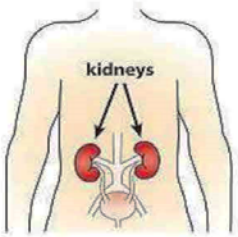
Appendix 3.10 CKD Educational material for participants

Chronic Kidney Disease

You have been told that you are at risk of developing chronic kidney disease (CKD). What does this mean? And what does this mean for your health and your life? This leaflet will answer some of the questions you might have.



You have two kidneys, each about the size of your fist. Their main function is to filter waste materials and excess amount of water from the body in the form of urine. They also help to:

- Control your blood pressure
- Maintain strong & healthy bones
- Produce blood

CKD means that your kidneys are damaged and are not functioning as they should. This can result in build-up of harmful waste materials in your body and also cause other problems that can damage your health.

Most importantly, this disease is 'progressive' which means it tends to get worse with time. Hence, if not managed appropriately, your kidneys might fail and then you will need dialysis or transplantation to maintain health. However, you can avoid this if you identify the risk factors which can cause CKD and then take steps to keep your kidneys healthier for longer.

Being over 50 is a risk factor, so as some people age they will experience a reduction in kidney function. While this risk is out of your control, there are many other lifestyle factors that you can change.

Alcohol

It is important to be smart about your alcohol intake. Although alcohol does not cause direct harm to kidneys, it may be dangerous if you already have kidney problems.

- Alcohol makes your kidneys to produce more urine than normal and it can have negative impact on other parts of the body that may contribute to kidney damage e.g. liver.
- Heavy drinking can lead to high blood pressure and heart disease which may contribute to kidney disease.
- Alcohol has high sugar content and may cause weight gain. This could eventually lead to diabetes - another risk factor for CKD.

So How Much Should I Drink To Avoid Any Effects On Kidneys?

- One standard drink (e.g. 100 ml wine, 285 ml full-strength beer, 30 ml spirit) 3-4 times a week may have a positive effect.
- Alternate alcoholic drinks with non-alcoholic beverages and remember to be SMART!!!!

Smoking

Smoking narrows the small arteries and vessels in your kidneys and reduces their ability to work properly. It can also cause cancer of kidneys, bladder and ureter.

So How Much Can I Smoke?

The message is clear don't smoke. The sooner you quit the better chance of keeping your kidneys healthy.

If you have problems quitting smoking, call QUIT line on 131 848 or ask your pharmacist for advice.

Cholesterol

Most of you know that maintaining a healthy cholesterol level is important to reduce the risk of heart disease but it's important to remember that high cholesterol can also have a negative effect on your kidneys.

So How Do I Know If I Have High Cholesterol?

- Eat a diet high in fibre and limit the amount of cholesterol-rich foods.
- Get your cholesterol levels checked regularly. The recommended level is no higher than 5.5mmol/litres.

Heart disease & high blood pressure

There is growing evidence that people at every stage of CKD are at a greater risk of heart disease.

Heart disease affects the heart and blood vessels such as your arteries and veins. For example, high blood pressure puts more stress on the kidneys and if this continues, then ultimately the vessels become thick and narrow which leads to a reduced blood supply. The final effect of this is reduced kidney function.

What Should I Do To Reduce This Risk?

- Choose foods with low salt (sodium)
- Aim to do some physical activity for at least 30 minutes 3-4 times a week.
- Keep your blood pressure in the target range as recommended by your doctor.

Diabetes

Diabetes is one of the most common causes of CKD in Australia.

- This disease affects the very small blood vessels in the kidneys and many people with diabetes do not realise that they have kidney disease. As a result, CKD remains undiagnosed.
- Diabetes significantly increases the progression of CKD to kidney failure.

What Can I Do To Manage This?

- Ask your doctor to have a kidney check.
- Keep your blood sugar level in the target range as recommended by your doctor.

If I Am At Risk Of CKD, Then Why Do I Feel Absolutely Normal?

CKD is also known as a **"SILENT"** disease, meaning that most people don't have any symptoms until their kidneys are about to fail. The only way to determine this is by undergoing a kidney health check. This can be performed by your general practitioner and includes:

(1) A blood pressure test

(2) A blood test

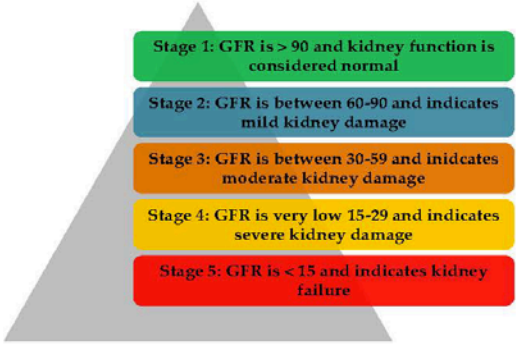
(3) A urine test

These tests will help you to monitor CKD and to determine how you are doing.

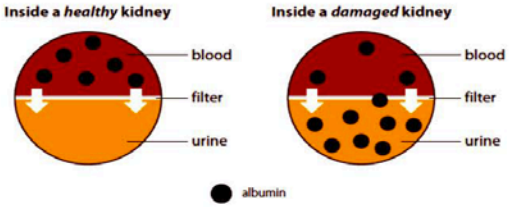
The most important thing you can do to slow down CKD is keep your blood pressure at a level recommended by your general practitioner. This can delay or prevent kidney failure.

The glomerular filtration rate (GFR) is the rate at which your kidneys filter waste products such as creatinine from your blood. Healthy kidneys usually remove creatinine from the blood and excrete it from the body in the form of urine. However, if your kidneys are not working properly, then creatinine stays in the blood.

The blood test measures your approximate GFR and if your GFR is above 90, then it's unlikely that you have CKD. If it is under 60, then you may have some kidney damage. CKD is grouped into various stages as follows:



Albumin is a protein in your blood which can get excreted via kidneys in higher quantities when your kidneys are damaged. However, you can lower the amount of albumin in urine with treatment. Lowering your urine albumin is good for your kidneys.



Do I Need To Change My Medicines?

Some medicines are not safe for people with CKD. Other medicines need to be taken in smaller doses. Tell your healthcare provider about all medicines you take, including over-the-counter medicines (those you take without a prescription), vitamins, and supplements.

Where Can I Get More Information?

Kidney Health Australia

http://www.kidney.org.au/

1800 682 531 (freecall)

UMORE (The unit for Medication Outcomes Research and Education) – Pharmacy, University of Tasmania aims to see improved community health as a result of our research and promotes the quality use of medicines.

UNIVERSITY of TASMANIA

Appendix 3.11 Letter to the GP

Letter to General Practitioner

Dear Doctor,

Re: 'Qkidney® Risk Assessment' screening study

Your patient ……. participated in the screening study 'Early identification of chronic kidney disease (CKD) via screening by community pharmacy' and has undergone the 'Qkidney® Risk Assessment' screening protocol. This study aims to identify people at high risk of developing moderate-severe kidney disease over the next 5 years and is being conducted by the Division of pharmacy, School of Medicine, at the University of Tasmania. The screening protocol uses 'Qkidney® Risk Calculator', a web based calculator for determining 5-year risk of developing moderate-severe kidney disease and can be accessed from the 'Kidney Health Australia' website.

The QKidney® algorithms were developed based on routinely collected data from many thousands of general practices across the United Kingdom and these algorithms have the potential to identify high risk patients who might benefit from more detailed assessment, closer monitoring or interventions to reduce their risk of kidney disease. The calculator requires height, weight and systolic blood pressure measures as well as responses to a few questions that relate to risk factors for CKD. It is a great educational tool as people also learn what factors increase their risk of developing CKD.

'Qkidney® Risk Assessment' screening study is a prospective cohort study and people with risk factors for CKD (such as hypertension, diabetes, heart disease, etc.) and who have not been previously diagnosed with CKD were screened to identify their 5-year risk of developing moderate-severe kidney disease.

Your patient …….. was identified as an eligible participant for this study and undertook the screening protocol on.../../…. The participant had a Qkidney® Risk of …….. for developing moderate-severe kidney disease over the next 5 years.

Please find attached with this letter participant's Qkidney® Assessment Data Form and Qkidney® Results Sheet.

If you have any questions regarding the study, please contact Dr Ronald Castelino via e-mail or telephone (Ronald.Castelino@utas.edu.au or +61 3 6226 1032) or Miss Pankti Gheewala via e-mail on Pankti.Gheewala@utas.edu.au or +61 3 6226 7288)

Yours sincerely,

Dr Ronald Castelino

Appendix 3.12 GP results sheet

Qkidney® results sheet
(General Practitioner Copy)

Participant ID	

Body measurement	Result
Height (cm)	
Weight (kg)	
Body mass index (kg/m^2)	

Blood pressure result (mmHg)	
Qkidney® risk result (Moderate or severe kidney disease)	

Speak to your general practitioner about your results

☐ At the first available opportunity

☐ In the next week or two

☐ At your next planned visit

If you are at an increased risk of developing moderate or severe kidney disease, you should ask your general practitioner for a kidney health check which may include: blood test, urine tests and blood pressure.

This study is being conducted by the Division of Pharmacy, School of Medicine at the University of Tasmania and funded by the Tasmanian Community Fund

For more information please contact:

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Appendix 4 PROJECT II (D)

CHAPTER 5. Patient satisfaction with a chronic kidney disease risk assessment service in community pharmacies

Appendix 4.1 Chronic kidney disease risk assessment satisfaction questionnaire

For each of the following statements, please tell us your level of agreement with the chronic kidney disease risk assessment service. 1 means that you entirely disagree with the statement and 6 means that you agree completely.							
		Strongly disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly agree
1	Risk assessment raised my awareness on chronic kidney disease	1 O	2 O	3 O	4 O	5 O	6 O
2	Chronic kidney disease risk assessment service is useful	1 O	2 O	3 O	4 O	5 O	6 O
3	Community pharmacy is a convenient place to perform chronic kidney disease risk assessment service.	1 O	2 O	3 O	4 O	5 O	6 O
4	The time required to undergo the risk assessment process was justified.	1 O	2 O	3 O	4 O	5 O	6 O
5	Privacy provided during the risk assessment process was acceptable.	1 O	2 O	3 O	4 O	5 O	6 O
6	I feel comfortable with the pharmacist referring my risk assessment results to my doctor.	1 O	2 O	3 O	4 O	5 O	6 O
7	The risk assessment results were clearly explained and understandable.	1 O	2 O	3 O	4 O	5 O	6 O
8	Brochures and leaflets provided on chronic kidney disease were informative.	1 O	2 O	3 O	4 O	5 O	6 O
9	Overall, I was satisfied with the chronic kidney disease risk assessment service.	1 O	2 O	3 O	4 O	5 O	6 O

Payment					
Would you be willing to pay for this service if it was offered on a regular basis?	☐ Yes		☐ No		
How much would you be prepared to pay for this service?	$ 5 O	$ 10 O	$ 15 O	$ 20 O	>$ 25 O

Are there any comments you would like to make regarding the chronic kidney disease risk assessment service?

Thank you for your cooperation in completing this survey.
Your involvement in this study is much appreciated.

Appendix 5 PROJECT III

CHAPTER 6. Knowledge about Chronic Kidney Disease (CKD) in the Australian Public Evaluated Using A New Validated Questionnaire: A Cross-Sectional Study

Appendix 5.1 Chronic kidney disease knowledge questionnaire

For Sections, 1-5, please answer 'True', 'False' or 'I don't know' to the following questions:

Section 1

No	Question	True	False	I don't know
1	A person can lead a normal life with one healthy kidney.	□	□	□
2	Herbal supplements can be effective in treating chronic kidney disease.	□	□	□
3	Certain medications can help to slow-down the worsening of chronic kidney disease.	□	□	□

Section 2 What functions do the kidney perform in our body?

No	Question	True	False	I don't know
4	The kidneys make urine.	□	□	□
5	The kidneys clean blood.	□	□	□
6	The kidneys help to keep blood sugar level normal.	□	□	□
7	The kidneys help to maintain blood pressure.	□	□	□
8	The kidneys help to breakdown protein in the body.	□	□	□
9	The kidneys help to keep the bones healthy.	□	□	□

Section 3 Which of the following are commonly used to determine the health of your kidneys?

No	Question	True	False	I don't know
10	A blood test.	□	□	□
11	A urine test.	□	□	□
12	A faecal (poo) test.	□	□	□
13	Blood pressure monitoring.	□	□	□

Section 4 What are the risk factors for chronic kidney disease?

No	Question	True	False	I don't know
14	Diabetes.	□	□	□
15	Being female.	□	□	□
16	High blood pressure.	□	□	□
17	Heart problems such as heart failure or heart attack.	□	□	□
18	Excess stress.	□	□	□
19	Obesity.	□	□	□

Section 5 What are the signs and symptoms that a person might have if they have advanced chronic kidney disease or kidney failure?

No	Question	True	False	I don't know
20	Water retention (excess water in the body).	□	□	□
21	Fever.	□	□	□
22	Nausea/vomiting.	□	□	□
23	Loss of appetite.	□	□	□
24	Increased fatigue (tiredness).	□	□	□

Appendix 5.2 Percentage of correct response to individual items on the questionnaire

Item No	Question	Correct response (%)		
		General public (n=121)	Student (n=28)	Nephrologist (n=27)
1*	A person can lead a normal life with one healthy kidney.	94.2	96.4	100.0
2	Herbal supplements can be effective in treating chronic kidney disease.	27.3	82.1	77.8
3*	Certain medications can help to slow-down the worsening of chronic kidney disease.	71.9	96.4	100.0
What functions do the kidneys perform in the body?				
4*	The kidneys make urine.	57.0	96.4	100.0
5*	The kidneys clean blood.	68.6	82.1	100.0
6	The kidneys help to keep blood sugar level normal.	18.2	50.0	85.2
7*	The kidneys help to maintain blood pressure.	24.8	100.0	100.0
8	The kidneys help to breakdown protein in the body.	17.4	57.1	81.5
9*	The kidneys help to keep the bones healthy.	15.7	64.3	100.0
Which of the following are commonly used to determine health of the kidneys?				
10*	A blood test.	77.7	96.4	100.0
11*	A urine test.	82.6	96.4	100.0
12	A faecal (poo) test.	49.6	89.3	96.3
13*	Blood pressure monitoring.	26.4	57.1	92.6
What are the risk factors for chronic kidney disease?				
14*	Diabetes.	71.9	100.0	100.0
15	Being female.	39.7	57.1	88.9
16*	High blood pressure.	52.9	100.0	100.0
17*	Heart problems such as heart failure or heart attack.	28.9	89.3	81.5
18	Excess stress.	13.2	35.7	81.5
19*	Obesity.	74.4	89.3	96.3
What are the signs and symptoms that a person might have if they have advanced chronic kidney disease or kidney failure?				
20*	Water retention. (excess water in the body)	72.7	82.1	96.3
21	Fever.	16.5	53.6	100.0
22*	Nausea/vomiting.	49.6	64.3	96.3
23*	Loss of appetite.	43.0	89.3	96.3
24*	Increased fatigue (tiredness).	76.0	100.0	100.0

***True items.*

Appendix 5.3 Results of the bivariate analysis performed using one-way ANOVA test between individual participant characteristics and total score

	Total score mean (SD)	Df[a]	F	p-value	Eta-squared[c]	Post-hoc comparison [b]
Total	***10.34 (5.0)***					
Age range (years)		2, 940	6.7	**<0.005**	0.01	50 + > 18 – 29, 30 – 49
18 – 29	9.9 (5.5)*					
30 – 49	9.8 (5.1)*					
50 +	11.0 (4.5)*					
Education		3, 939	4.7	**<0.005**	0.01	Higher degree or post diploma/Bachelor degree > Completed highest level of school
Higher degree or post graduate diploma/Bachelor degree	11.0 (5.0)*					
Diploma/Vocational	10.5 (4.8)					
Completed highest level of school	9.4 (5.3)*					
Did not complete highest level of school	9.7 (4.7)					
Occupation		5, 937	3.3	**<0.01**	0.02	Professional/ Managerial > Sales/Clerical, Unskilled/Labourer
Professional/Managerial	11.2 (4.7)*					
Sales/Clerical	9.4 (5.4)*					
Technical/Skilled	10.0 (5.2)					
Unskilled/Labourer	8.9 (5.3)*					
Other occupations	10.8 (5.0)					
Do not work	10.4 (4.8)					
Work outside home		2, 940	0.2	0.815	NA	NA
Yes, full-time	10.2 (5.2)					
Yes, part-time	10.3 (5.1)					
No (Not employed, student, work at home, homemaker, retired, etc.)	10.4 (4.8)					
Gross annual income		3, 939	5.3	<0.005	0.02	Refused < Under $50,000, $50,000 to just under $100,000, $100,000 and over
Under $50,000	10.3 (4.9)*					
$50,000 to just under $100,000	10.6 (4.9)*					
$100,000 and over	10.9 (5.1)*					
Refused	8.6 (5.1)*					
Marital status		2, 940	7.0	**<0.005**	0.01	Single/Never married < Married/Common law, De-facto or Living with a partner, Divorced/Separated/Widowed
Married/Common law, De-facto or Living with a partner	10.5 (4.7)*					
Single/Never married	9.3 (5.6)*					
Divorced/Separated/Widowed	11.1 (4.7)*					
Number of people in the household		4, 938	1.3	0.265	NA	NA
One	10.2 (5.2)					
Two	10.6 (4.9)					
Three	10.8 (4.8)					
Four	10.0 (5.0)					
Five or more	9.4 (4.9)					
Area description		3, 939	1.2	0.306	NA	NA
Within a capital city	10.4 (5.0)					
Within a major regional city	10.2 (4.9)					
Within a rural town or its surrounds	10.7 (4.8)					
More than 5km from the nearest town	8.8 (5.4)					
Location		7,935	0.6	0.789	NA	NA

Victoria	10.3 (4.9)					
Western Australia	10.4 (5.2)					
Tasmania	10.2 (4.3)					
ACT	11.8 (4.1)					
Northern Territory	9.7 (1.5)					
NSW	10.6 (5.1)					
Queensland	10.1 (4.9)					
South Australia	9.8 (4.8)					
Do you have any of the following medical condition(s)/illness (es) that require you to take regular medications?						
High blood pressure known as hypertension		2, 940	12.3	**<0.001**	0.03	
Yes	11.1 (4.4)*					I don't know < Yes, No
No	10.3 (5.1)*					
I don't know	5.4 (5.6)*					
Raised blood sugar known as diabetes		2, 940	12.0	**<0.001**	0.02	Yes > I don't know, No; No > I don't know
Yes	11.8 (4.0)*					
No	10.3 (5.0)*					
I don't know	6.1 (5.6)*					
Heart problems such as heart failure or heart attack		2, 940	6.0	**<0.005**	0.01	
Yes	10.9 (4.8)*					I don't know < Yes, No
No	10.4 (4.9)*					
I don't know	6.9 (5.9)*					
Personal history of stroke		2, 940	11.6	**<0.001**	0.02	
Yes	12.8 (4.6)*					I don't know < Yes, No
No	10.4 (4.9)*					
I don't know	6.1 (5.6)*					

[a] df values (Between groups, Within groups)

[b] Tukey HSD post hoc comparison (*p<0.05)*

*, Bold indicates variable with a statistical significance that will be included in the multiple linear regression model

[c] Cohen classifies Eta-squared value of 0.01 as a small effect, 0.06 as a medium effect and 0.14 as a large effect.

Appendix 5.4 Results of the bivariate analysis performed using Independent t-test between individual participant characteristic and total score.

	Total score Mean (SD)	***t***	***df***	***p-value***	***Eta-squared[a]***
Gender		1.19	941	0.24	
Female	10.5 (4.9)				
Male	10.1 (5.0)				
Country of birth		-1.19	941	0.23	
Australia	10.5 (4.9)				
Not Australia	10.0 (5.1)				
Children under 18 years of age		-0.08	941	0.93	
Yes	10.3 (4.9)				
No	10.4 (5.0)				
Are you of Aboriginal or Torres Strait Islander descent?		-0.56	941	0.56	
Yes	9.6 (5.4)				
No	10.4 (5.0)				
Does anyone in your immediate family work as a registered healthcare professional e.g. doctor, nurse, dietician or pharmacist?		1.32	941	0.19	
Yes	11.2 (4.5)				
No	10.3 (5.0)				
Do you have a family history of kidney failure?		3.23	941	**<0.01**	0.01
Yes	12.2 (4.6)				
No	10.2 (5.0)				

Bold indicates variable with a statistical significance that will be included in the multiple linear regression model

[a] Cohen classifies Eta-squared value of 0.01 as a small effect, 0.06 as a medium effect and 0.14 as a large effect.